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Practical Diesel Engineering

As a very considerable proportion of our readers—over 1,700—are operating engineers, it is not surprising that many requests are received by the editorial staff for information regarding the practical operation of marine machinery. Of these requests for "practical" articles, approximately four out of every five ask for information relative to Diesel engines and their operation.

The growing importance of the marine Diesel engine resulting from the rapidly increasing number of motorships of all classes has aroused the interest of all forward-looking engineers, and there is a growing demand for the discussion of the motorship machinery plant from the practical angle not exhaustively treated in the books so far published.

There is, in the large amount of Diesel engine literature now available in the form of books and magazine articles, much good material for the designer, the student and the practical engineer. The sort of information sought by the man in the engine room, especially the large number of marine steam engineers who will eventually be called upon to operate Diesel engines must, however, be culled from so many different sources as to render it not readily available and necessarily of a rather fragmentary character.

It seems quite evident that there is, in the coordinating and arranging of the mass of disconnected material which has a bearing upon practical Diesel operation as well as in the setting forth of the personal knowledge of the subject gleaned from the experiences of a skilled seagoing Diesel engineer, an opportunity for a constructive work of great value and usefulness.

While the call for articles on the practical side of Diesel engineering is quite fully appreciated, their realization has not proved an entirely easy matter for the editors. There are many able engineers who are thoroughly familiar with every phase of the Diesel problem, from the practical as well as the theoretical point of view, but it has seemed particularly desirable to have the subject treated by one who combines expert knowledge with practical engine room experience with steam as well as internal combustion machinery, being thus enabled to consider it from the viewpoint of the man for whom the articles are particularly intended.

In Mr. Louis R. Ford, the editors believe they have found an engineer who entirely fulfils their requirements. Not only has he had extended experience with various types of Diesel engines but he enjoys the somewhat unusual distinction of having risen to commissioned rank in the navy by way of the enlisted personnel. Being a consulting engineer and not directly associated with the producers of any particular type of engine he can naturally treat his subject in a broader and more unprejudicial manner than would otherwise be possible, while his long sea experience has given him an understanding of the sort of information which the man in the engine room wants and the ability to tell it in the latter's own language.

To get an intelligent insight into the practical operation of any machine, at least a fundamental knowledge of the principles upon which it works is quite essential. To this end, the first of Mr. Ford's series of articles, which appears in this issue, and the one following it, next month, will be devoted to the consideration of elementary principles, as a necessary introduction to the practical articles which will follow.

It is not the intention to include in the present series detailed descriptions and illustrations of the various types of Diesel engines, except to such extent as may be necessary to make clear certain points in connection with the problems of operation which are discussed. The articles will, however, be eventually published in book form and in this it is proposed to include complete information and plans of the leading types of Diesel engines.

The body of the articles, after the introductory chapters covering in a brief way the theoretical considerations underlying the operation of the Diesel engine have been disposed of, is intended to cover, in detail, the following general outline of subjects bearing directly upon actual engine room opera-

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tion, approximately each heading being covered by a separate monthly article: Erecting and starting, normal operation, derangements and adjustments, lubrication of oil engines, bearing adjustments, ignition failures, setting valves, practical indicator work for oil engines, oil engine fuels, performance data and records and instructions for obtaining a license as an oil engine operator.

While the present articles are designed primarily to meet the expressed desire of operating engineers, we hope and believe that they will prove to be of real value to everyone interested in marine Diesel engines, whatever his viewpoint may happen to be.

Congress

WHILE the shipping world has, in the authorization of the Diesel conversion program, received favorable consideration at the hands of Congress and can be duly thankful that its pressing needs are, at least, receiving official recognition, it cannot be denied that the session just brought to a close has been productive of little real satisfaction to the general public.

With a few exceptions, the time has been spent in investigations, showing, to date, no substantial results and productive of little else than a general feeling of dissatisfaction all over the country and useless talk and discussion. The result has been that nearly all attempts, on the part of the administration, towards really constructive and useful legislation have been blocked. Throughout, constructive and much needed action has been subordinated to personal ends and political expediency.

In no case has the failure of Congress to act and its evident carelessness of the general welfare and safety of the country's future been more glaringly apparent than in its final disposal of the bill to increase the Navy, practically accompanied, as it was, by what has been evidently taken as an insult by a powerful foreign nation. Nothing could be more inconsistent, nor show more clearly the entire lack of organization and ability for intelligent and coordinated action on the part of the legislative branch of our government, than this last-minute failure of the naval bill.

With the experiences of 1898 and 1917 as a background, it is difficult to see how any public spirited citizen, much less any member of Congress, can, for a moment, consider any action calculated to embarrass the Navy, or subordinate its needs to any other question whatsoever.

The *fact* of war is a greater reality today than ever before in the memory of living man, notwithstanding the theories and assertions of pacifists to the contrary. Undoubtedly the world wants to make war impossible, but it is a long, long way from having found out how to do so, and in the meantime the opportunities for international misunderstandings were never greater nor more apparent than at the present moment. Congress, itself, has furnished the most convincing proof of the truth of this assertion.

We believe, most sincerely, that the administration, itself, has no intention of allowing the Navy to fall below the full strength allotted to it by the disarmament conference, but, in suggesting the desirability of a further reduction of armaments, it has opened the door for a flood of protests from radical and pacifist sources against the proper support and maintenance of both the Navy and the Army.

The power of our battle fleet has, for the present, been effectively disposed of. As the result of the failure to authorize the increased elevation of the guns on the older ships, over two-thirds of our fleet will be outranged by British ships for the next ten years. During this period, England will add two new superdreadnaughts to her fleet. We shall build none.

Turning to smaller and secondary vessels, cruisers obviously increase in fighting importance as the actual battle fleets are reduced. We are already behind in this class of vessel and the failure of the naval bill, together with the possibility of further international action in regard to disarmament, makes the probability of Congressional action to correct our obvious naval deficiencies at least problematic.

It is a far more vital matter than the politicians and the general public appear to realize, and in certain, and by no means impossible, eventualities, will be productive of the most serious and unfortunate results.

In such case there will be a wild clamor to fix the blame, but the harm will have been done, and, if the country finds itself involved in war, with the odds of success overwhelmingly against it, fixing of blame and the branding of scapegoats will not greatly lessen the bitterness of loss and failure.

Now is the time to act. Both great national parties will undoubtedly affirm the need of a strong Navy in their platforms but the country requires something besides lip service to defend it against its enemies and it cannot afford any longer delay in seeing to it that effective action to insure its future safety and prosperity be taken at once.

Ship Data

AS time goes on, engineering, like every other matter of human concern, becomes more complicated, is constantly increasing its range and requiring more and more, expert knowledge and specialized experience.

Not so many years ago there were men who carried "in their heads" all, or nearly all, of the information necessary for the designing and building of a successful engineering structure, were it ship, engine, bridge or building. They were of necessity, essentially rule-of-thumb engineers, but a sense of fitness and proportion, apparently inborn, as well as the simplicity, judged by modern standards, of the problems they were called upon to solve, insured success, so long as no wide departure from accepted standards or practice was attempted.

There are still, in the shipbuilding industry, at least, a few men whose "pigeon hole" memories and unerring engineering judgment, enable them, with but little aid from memoranda or records, to approximate a workable solution of almost any problem of design or construction, but the expansion of every branch of engineering science has now become so great, that no man can have at his fingers' ends all the results of the ever increasing volume of accumulated experience.

It has been said, and the truth of the saying increases as

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time goes on, that the best engineer is not he who has an answer always ready, but rather the one who knows where to find the information which he needs, and, having found it, has the knowledge and judgment to apply it correctly and effectively to the solution of the question in hand. The present-day engineer's ability must, then, rest largely on the data and information at his command. To be of use, this information must be correct. Furthermore, and of equal importance, the circumstances and conditions surrounding its compilation must be thoroughly understood by the one who proposes to make use of it.

Data are defined as a collection of "facts, either indubitably known or treated as such for the purposes of a particular discussion."

Probably every draftsman has passed through the period, when each stray sheet of miscellaneous information, or random blue print, seemed a particularly desirable possession, a "fact" to add to his stock of knowledge. Such data may, at times, have a certain educational value, if carefully studied and considered in their true light, but of what real value, as an authentic basis for actual use in engineering work, is a large proportion of such fragmentary and ill digested material?

For engineering data to be of use or, it might well be said, to prevent their becoming a positive source of harm, it is necessary, first that the methods by which they are obtained should be, as nearly as possible, absolutely accurate and second that they should be so arranged, or accompanied by such supporting explanation, as to make their meaning perfectly clear.

For example, suppose a data sheet relative to a certain ship records her metacentric height, in load condition, as 2 feet. In the first place the question at once arises: Is this figure the result of calculation or experiment and, in the latter case, was the ship heeled in a proper manner, with no loose water on board and all calculations necessary to fix the position of the center of gravity in light condition accurately made? Secondly, what is meant by load condition? How was cargo assumed to be stored and what amount of fuel and water allowed for and how stored? All these things must be definitely known, in order to give the recorded G. M. a real value as a basis of comparison in getting out a new design.

Far too often, a shipyard has but little data of the vessels it has turned out. Trial trip results are rarely in a form to be of any constructive use, many ships are not heeled at all, weight records, other than those accompanying cost returns and covering gross quantities only, are rarely kept, and frequently even the information on the deadweight scale, which certainly should be authentic and reliable, is in serious error, or given in such a meager fashion as to leave its actual significance in doubt.

We have in mind the capacity plans of two sister ships, built, presumably, from the same plans, notwithstanding which there was a variation in the cubic capacities given of over 10 percent between the two vessels. It developed that in one case bale capacity had been given, and in the other grain, but there was no indication of what the figures represented, on either plan. While this may be an extreme case, it serves to illustrate the point we are trying to make—of the necessity of clearness, as well as accuracy, in all recorded data.

While we are considering, more particularly, shipyard or personal records, the criticism applies equally to data of various sorts, as published in the numerous engineering hand books. We once heard a rather well known engineer express the opinion that one handbook was as good as another as the tables of areas of circles and cubes of numbers were the same in all. The implication is a little hard, on the better class of books, which contain a vast amount of authentic and useful information, but too often, much fragmentary and incomplete description and data are interposed, sometimes quite contradictory, thus throwing in doubt the accuracy and reliability of the whole work.

What we have said with reference to general data of physical properties and qualities applies with even more force to cost records. The past decade has witnessed a great improvement in the manner of keeping cost accounts insofar as methods are concerned but we venture to suggest that the quality of the work turned out has not always shown a corresponding increase in accuracy and value.

It is, of course, very desirable to have records of the cost of the individual parts, or classes of work, which go to make up the total of a ship's structure, but detail costs which are obtained at the expense of accuracy are of little or no use. Too often, the making up of cost records and data is left entirely in the hands of accountants who have not the experience necessary to judge correctly the cost slips, when sent in from the yard or ship, and to detect errors in the assignment of material and costs to different structures.

It has always seemed to us most desirable that the staff of accountants concerned with the making up of cost returns should include in its numbers at least one man having a practical knowledge of shop operation as well as a true sense of proportions—in other words, an expert cost estimator. In this way the probability of detecting an error in the shop returns is greatly increased and an investigation made at once of any doubtful figures while the matter is fresh in every one's mind. Thus, the chance of including uptakes with boilers, carpenter decks with joiner work and other similar and by no means unusual errors would be eliminated, or, at least, much reduced and a reliability given to detail costs approaching that which usually characterizes the total for the complete vessel.

Neither the naval architect, the engineer nor the cost estimator can be too careful in the use of the data which come to his hand. A small amount of correct and trustworthy information, thoroughly understood, is of inestimably greater value than a mass of uncoordinated and half developed records and no work of greater eventual value can be carried out by a shipyard or other engineering establishment than the complete and painstaking recording of all essential information relative to its products. In common with all other activities which come into the general sum of overhead, such work is often frowned upon as causing unnecessary expense but it is hard to see any more valuable and essential property for a contracting establishment than a correct record, both as to physical qualities and cost, of the work which it has turned out.

For use in design and estimating work, data, to be effec-

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tive, should, so far as possible, be coordinated and standardized in such a way as to be readily adaptable to the making of comparisons. Thus the weight of steel in a ship's hull may be expressed in the form of a coefficient or factor based upon the volume (cubic number), surface (surface feet), upon the sectional area of material at the midship section or upon the weight of a complete "frame space" at the midship section. Either method, when properly handled, will give good results, although it is our experience that weight factors based upon the midship section are, in general, more uniform and consistent than those dependent upon volume or surface alone. Right here, the necessity of clearness becomes most apparent. The steel weight should clearly indicate whether it includes superstructures, houses and spars, or whether, as should be the case, these have been kept separate. Quite often, all are jumbled together in the shop returns, but no mention made of the fact in the final records.

While steel weights and costs lend themselves quite readily to the use of factors and coefficients, the same cannot be said of wood, outfit and other miscellaneous weights and quantities. With them satisfactory results can be obtained only by careful calculations for each individual case, based upon accurate records of previously constructed vessels.

The records of amount of wood used in carpenter and joiner work seem to need particular attention. Here the service rendered by a competent estimator in the cost department may be particularly apparent.

The weights of all propelling machinery should be carefully kept, the relatively trifling cost of weighing being far outborne by the value of accurate records. There are many methods of standardizing machinery weights and costs. For engines, the cylinder volumes are as good a basis as any, having in mind, of course, that any factors or coefficients will vary widely with piston speed. In the case of turbines, records may best, perhaps, be based on weights and revolutions. For boilers, the heating surface, combined with the working pressure, forms a very satisfactory basis.

So far, our remarks have had to do with questions which bear mainly upon weights and costs. Turning to the physical and operating qualities of a vessel, there is a vast amount of information, of utmost importance to the naval architect and designer, and of scarcely less interest and value to the shipowner and operator, which may be obtained and recorded with a relatively small expense of time and money.

Probably all engineers will agree that the greatest lack of reliable data lies in the field of powering and speed. The proportion of mercantile vessels, for which really accurate and reliable trial data exist, is surprisingly small. Most owners appear to feel that towing a model is all that is necessary in the determination of power and quite fail to realize that unless backed up by trial records the model resistance is of very restricted use and is but one factor in the determination of the actual power necessary to obtain a given speed. While it is not often practicable to have a progressive speed trial, in load condition, for a new merchant vessel, very much could be accomplished by a little intelligent cooperation between owners and builders. Although the determination of a speed and power curve covering the region of ordinary service speed is, of course, much to be desired, it is not often practicable to run a progressive trial of a ship in service. The actual fixing of a single spot at or near the designed speed is, however, all that is necessary to give the model results a very real value and to determine the efficiency of propulsion of the ship and its propeller under service conditions. In almost all services, the opportunity to make an accurate determination of this kind, with little or no loss of time, is frequently presented and we believe that many operators would meet the builders at least "half way" in the attempt to collect and check such information.

Turning to questions of stability and trim, the former assume their greatest importance in passenger ships, the latter are vital in every class of vessel. Where good crane service is available the heeling of a ship becomes a simple matter. It seems to us that for its own information and protection, if for no other reason, a shipyard should heel every important vessel which leaves its hands, this applying even to duplicate ships where the second heeling may be the means of uncovering an error in the first experiment. Trim is mainly a matter of figures, but too often a ship leaves the yard with the observed drafts unaccompanied by a clear and accurate record of the amount and position of weight on board. A set of "Bonjean" curves of cross section areas should be included in the data of every important vessel.

Complete steam trials are expensive and, for any but government vessels, it is rarely practicable to undertake them, but, here again is the chance for practical cooperation—between the designing engineer on shore and his brother in the engine room. With the greatly increased use of fuel oil, the accurate determination of the amount of fuel burned is becoming less difficult, and, taken together with a little careful and consistent use of indicator or torsion meter, will produce results throwing light upon a subject about which much is said, but very much less is really known. All that is needed, granting the engineer is really and wholly interested in his work, is systematic procedure and careful attention to and recording of details.

The obtaining and compilation of accurate engineering data are, in the last analysis, very largely dependent upon the active and enthusiastic interest in and devotion to his work of the engineer. No care is too great in insuring accuracy of observation nor can there be lack of patience and perseverance in checking all results and recording all the conditions surrounding them. No perfunctory work or loose methods can be tolerated, if the final results are to justify the time and effort necessary to obtain them.

The work now being done by the Marine Standards Committee, in certain of its phases, seems to have a rather direct connection with the physical properties of vessels. Standard methods of recording information relative to these characteristics would have many advantages.

We are not to be taken as suggesting that this information should be standardized and broadcast, but simply that the *methods* of recording it be standardized, thus giving it a definite and generally understood value.

We know many men among the shipyards and steamship lines of this country, experts in their respective lines and devoted to their work, some of whose time, valuable as it is, could well be devoted, by their employers, to the compilation of accurate data. Money thus invested would, in most every case, return a high rate of interest.

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Practical Diesel Engineering

Action of Gases in a Cylinder—Definitions — Pressure-Volume Curves — Cycles and Cyclic Processes—The Otto and Diesel Cycles

By Louis R. Ford*

IN order for the oil engine operator to apply with intelligence the skill he may develop by actual practice with the machinery intrusted to his care he must have at least an elementary knowledge of what is occurring inside the cylinders when the engine is in operation. The interior of the cylinder is the point at which the power to do work is produced; the rest of the engine merely serves as a medium for transmitting this power and converting it to useful work. It is not sufficient for the operator to know that under certain conditions he must do certain things, perform certain operations, in order to correct wrong conditions and make the engine run properly. He must know why the performance of these operations produces the desired results, and to do this he must understand the processes that are enclosed within the engine. The study of processes of this nature constitutes a branch of the science known as thermodynamics. Since this discussion is concerned solely with the practical operation of oil engines such study will be touched upon only enough to prepare the engineer for correct understanding of his engine. The discussion of what we may term "internal processes," which follows, has been reduced to the simplest form and made as brief as is consistent with obtaining an understandable mental picture of what makes the engine run. The operator who wishes to study further this phase of Diesel engineering will find a wealth of material in the numerous books on the subject that are now available.

The oil engine, as well as every other kind of reciprocating piston engine, derives its power to do work from the movement of its piston back and forth from one end of the cylinder to the other, this reciprocating motion being in most cases converted to rotating motion for the application of the power to the purpose desired, and this movement of the piston is caused by the pushing force of some kind of fluid on one side of the piston. In the case of the Diesel engine this is a gaseous fluid, or gas, generated by the burning of the oil within the cylinder. Every gas will expand when heated unless it is prevented by some restraining influence, such as the walls of the vessel in which it is contained. This tendency to expand will, if restrained in this way, produce a pressure against the walls of the container. If the container is in the form of a cylinder and one of the restraining walls is a piston that can move in the cylinder, the pressure exerted as a result of the tendency of the gas to expand will cause this piston to move outward thus increasing the volume of the cylinder and allowing the gas to expand. If the piston, in order to move under the influence of the expanding gas, has to push a load, or is in any way restrained from free movement, the gas does work in pushing the piston and the amount of load that can be forced outward by the piston is a measure of the amount of work done by the expanding gas.

In the study of heat processes it has been established that, if a gas that is free to expand is heated, it will expand and increase in volume and laws have been established by which the amount it will expand with the application of a given amount of heat can be definitely calculated. Likewise, by the application of the same laws, the amount of heat that will be required to expand a given quantity of gas a given amount may be definitely calculated. Now if the gas is confined in a closed vessel so that it cannot expand and increase its volume, and heat is applied, the tendency of the gas to expand will cause a rise in pressure inside the closed vessel. The amount of pressure rise thus produced will be proportional to the amount of heat applied to the gas. By the laws just referred to the amount of heat required to produce a given pressure in a given quantity of gas, or, conversely, the pressure that will be produced by heating a given quantity of gas a given amount can be calculated. From these facts it may be seen that in considering a gas its pressure, temperature and volume always have a definite relation to each other and it is impossible to change one without changing at least one of the others. Into the steam engine cylinder we introduce a gas, called steam, which is produced by the evaporation of water in a separate vessel, called the boiler. The natural tendency of this gas to expand forces the piston to the opposite end of the cylinder and the increase of volume causes the steam to lose most of its pressure. It is removed from the cylinder and high pressure steam is introduced on the other side of the piston, forcing it back to the other end of the cylinder.

In the Diesel engine cylinder the same process is carried out in a slightly different manner. The liquid oil is introduced into the cylinder, mixed with air and ignited. The burning of this oil converts it to gas and produces a large amount of heat which raises the temperature of the gas and produces a high pressure. This pressure causes the piston to move to the other end of the cylinder, increasing the cylinder volume and permitting the gas to expand, thereby reducing its pressure and temperature. At the end of the stroke the gas is removed from the cylinder and the piston is returned to its original position in the cylinder. This action will be explained in detail further on.

The foregoing examples illustrate the action of gas in a cylinder when the gas is performing work, being reduced in pressure and losing heat as a result of this performance of work. Exactly the same sort of thing occurs, in the reverse order, when a gas is compressed from any volume to a smaller one. In this case, with the piston at one end of the cylinder, the cylinder is filled with gas and some force, usually mechanical, applied behind the piston to force it to the other end of the cylinder. This compresses the gas into a smaller volume and by reason of this reduction in volume its pressure and temperature are increased. The important examples of this in connection with the Diesel engine are the compression of air used for injecting the fuel oil into the cylinders and for starting the engine, and compression in the power cylinders of the air required to burn the oil. As has been explained, when a gas at high pressure and small volume is allowed to expand to a lower pressure and larger volume it does work; in a like manner, if gas is compressed from a low pressure and large volume to a higher pressure and smaller volume work must be done upon it.

Definitions

Before proceeding further it is desirable to understand the meaning of some of the terms used in discussing the action of gases in a cylinder, especially the three inseparably connected ones—pressure, volume and temperature. Pressure

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is defined as the force exerted per unit area on any surface. Except in countries that use the metric system of measurement the unit of area in ordinary use is the square inch and the unit of force is the pound and, as understood in everyday engineering practice, pressure is the force in pounds exerted on one square inch of area.

As used in theoretical calculations the definition is slightly different and it is necessary to use specific terms to explain the units being used. In calculations concerning gases the term pressure is usually understood to mean the absolute pressure in pounds per square inch of area. The atmospheric air surrounding the earth exerts a normal pressure, at sea level, of about 14.7 pounds per square inch. This pressure varies with atmospheric conditions but the variations are slight. For ordinary practical engineering work atmospheric pressure is taken as 14.7 pounds per square inch and the ordinary pressure gages, with which engineers are familiar, are considered to register pressures above this amount. Unless otherwise stated ordinary gage pressures will be used in these articles. Terms such as "100 pounds pressure" will have the ordinary engine room meaning, 100 pounds above atmospheric pressure per square inch, which is equivalent to 100 plus 14.7, or 114.7 pounds absolute pressure per square inch.

Volume is a measure of space or capacity and is the product of the three linear dimensions, length, width and depth, or in the case of cylinders, area times length or depth.

Temperature is an indication of the physical state of a substance and is measured by an instrument known as the thermometer. For high temperature measurement, such as the temperature of the exhaust gases in a Diesel engine, the type of thermometer used is called a pyrometer. Temperature is not properly a measure of the amount of heat contained in a substance. Water at sea level may be raised to 212 degrees by adding heat but quite a large amount of heat may be added to it at this temperature without causing any change in temperature. On the other hand, to the engineer who is familiar with the processes involved in every day engineering work, such as compressing air, the statement that a certain volume of air after compression has a temperature of 1,000 degrees conveys a very definite impression as to the amount of heat added to the air. It may be said, then, that while temperature is not a measure of the heat contained in a substance it is usually an indication of the amount of that heat.

There are two kinds of thermometers in general use for measuring temperatures, the Centigrade and the Fahrenheit. For engineering work in the United States the Fahrenheit is most commonly used but, in order to prevent mistakes, it is customary to use the letters C. or F. after the temperature to indicate which scale is used. The Centigrade thermometer has a scale on which the temperature corresponding to the freezing point of pure fresh water at atmospheric pressure is 0 degrees, the boiling point is 100 degrees and between these points there are 100 equal divisions. On the Fahrenheit scale the freezing point is at 32 degrees and the boiling point at 212 degrees, with 180 equal divisions between. In calculations concerning the action of gases the temperature used is the absolute temperature. This is the temperature at which a constant volume of gas would have zero pressure. It is a temperature never reached in practice but which has been determined by laboratory experiments to be roughly 460 degrees below the zero point on the Fahrenheit scale. For a substance showing a scale temperature of 60 degrees, then, the absolute temperature will be 460 degrees plus 60 degrees, or 520 degrees.

The British thermal unit, commonly abbreviated to B.t.u., is the unit used to measure the heat contained in a substance. It is the amount of heat required to raise the temperature of one pound of water one degree. This amount is not exactly the same for all temperatures of water, so for ordinary purposes an average is determined by dividing the amount of heat required to raise one pound of water from 32 degrees F. to 212 degrees F. by 180, the number of degrees between those two temperatures. This unit is of great importance to the Diesel engine operator as it is used to measure the value of the fuel oil used and to measure the efficiency of the engine. The total number of B.t.u's. contained in one pound of oil determines the amount of work possible to obtain from that pound. It will be shown later that the percent of the total heat in a pound of oil that is converted to useful work is the thermal efficiency of the engine.

Since there is a very definite relation between heat and work it is possible to express B.t.u's. in terms of work, work being expressed in foot pounds, the equivalent of moving one pound one foot in one minute. It has been experimentally determined that it requires 778 foot pounds of work to raise the temperature of one pound of water one degree Fahrenheit, therefore one B.t.u. is equal to 778 foot pounds.

When gases are compressed or expanded there are two theoretical conditions under which this compression or expansion occurs. Under the first condition the compression or expansion takes place without any change in the temperature of the gas, and is known as isothermal. It has been previously explained that compression of a gas always produces a rise in temperature and expansion always produces a drop in temperature. In order, then, to compress and expand isothermally it is necessary to cool the gas during compression to prevent a rise in temperature and add heat during expansion to prevent a drop in temperature. If the compression or expansion takes place with no heat added to or taken away from the gas during the process, it is known as adiabatic. Theoretically this is the condition under which compression and expansion occur in the Diesel engine cylinder but actually it is a condition that does not exist, because the metal of the cylinder walls and piston absorbs a large amount of heat.

When oil is burned in the oil engine cylinder, resulting in the production of a highly heated gas (actually a mixture of several gases), the burning, or combustion, occurs under one of two conditions; in one the piston is practically stationary during the time of combustion, so that the gas cannot expand and increase its volume. It has been explained that the pressure, volume and temperature are so related that if one is changed then one or both of the remaining two must change, so in this case, where heat is added by the combustion of the oil and the volume is fixed, the pressure must increase. This process is known as "combustion at constant volume." In the second condition the gas produced by the combustion of the oil expands behind the moving piston while combustion is taking place. The movement of the piston in the cylinder increases the cylinder volume at the same rate at which the gas increases its volume by expansion, so that the pressure does not rise. This process is known as "combustion at constant pressure." These two processes and their application to actual engines will be more fully explained later.

Curve Plotting Applied to the Action of Gases

Since we know that the three variables, pressure, volume and temperature bear a fixed relation to each other, and any change in one must result in a change in another, we know that, whenever any two are being considered, for every value of one there is a corresponding value of the other. The relation between these three variables, which is before us every day in all operating engines, is known as the P.V.T. relation. The two with which we are most often called upon to work in every day oil engine operation are pressure and volume. For the condition just stated, where every value of P must have a corresponding value of V, these values may be arranged in the form of a table, but it is very difficult to get a correct mental picture of the relation between the two from the table, so when considering any two related variables such as these, or when seeking to determine what relation

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any one set of variables has to another set, we resort to what is known as curve plotting. This gives us a picture, or graphical representation of the effect any change in one has on the other.

The curve is known as a graph. Curve plotting is done on paper divided into squares by ruling equally spaced lines horizontally, crossed by equally spaced vertical lines. Paper ruled in this way is known as cross section paper and it is usually divided into squares measuring one-tenth of an inch on each side, the spaces between the horizontal lines and those between the vertical lines each being 1/10 inch.

The method of using this paper is best explained by an example. Consider the following table, which gives the value of pressure in a certain cylinder at different cylinder volumes:

Pressure in pounds per square foot.....	18,000	12,600	9,440	7,560	4,320	2,880
Volumes in cubic feet.....	1.1	1.3	1.6	2	3	4

These two variable quantities, which we will denote as P and V, are connected in such a way that whenever the value of V is fixed the value of P corresponding is also fixed. For any value of V whatsoever, whether it is given in the table or not, there is a corresponding value of P. Now if, in

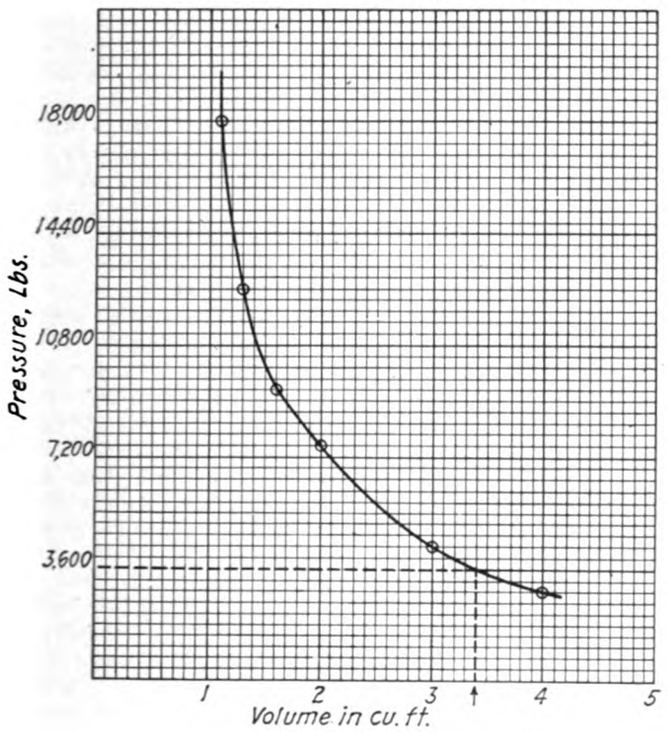

Fig. 1

Fig. 1, we lay off on the vertical margin of a piece of cross section paper a scale to represent P, and on the horizontal margin a scale to represent V, we can use the figures in the table to locate a set of points. Our highest pressure is 18,000 so we see that, if we take five main divisions on the scale, each line, being 1/10 inch, will represent one-fiftieth of 18,000, or 360 pounds pressure. Then if we let each main division on the horizontal line represent one cubic foot, each small division will represent 1/10 of a cubic foot. Now on the line representing the 18,000 point move out horizontally 11 divisions and that point will represent 1 1/10 cubic feet and this will be our first point. The next pressure is 12,600, which is 5,400 less than 18,000. Since each line represents 360 pounds this point will be 15 lines below the first point. The V corresponding to 12,600 in the table is 1.3 so we move out on the horizontal scale 13 divisions and plot our second point. After all the points are located in this manner draw a smooth curve through all of them. We now have a picture of how P changes with V and, if we have a value of V not given in the table, such as 3.4, and wish to know what pressure will exist in the cylinder at this volume, we simply locate 3.4 on the horizontal scale, move up the vertical line until the curve is reached, then along the horizontal line to the P scale and we find that the pressure corresponding to this volume is 3,600 pounds.

The method by which this curve is drawn indicates a method by which we can get a picture of what is happening inside the cylinder of our engine, for every process that occurs in the cylinder, with attendant variations in pressure, volume and temperature can be illustrated by means of a curve and these curves may be combined to make a complete diagram.

When the gas in an engine cylinder is expanding behind the moving piston even the most minute increase in volume causes a corresponding decrease in pressure, so it is evident that from the time when expansion begins the pressure forcing the piston toward the end of the cylinder is less for every position of the piston. By means of mathematical formulæ to be explained later, we can calculate the pressure acting on the piston at any point in the stroke but an infinite number of such calculations would be required if we wished to determine in this way the pressure acting at every point throughout the complete stroke. By means of a curve drawing machine, known as the indicator, we may, however, obtain a set of curves combined into a diagram that will show us at a glance how the pressure is changing with the volume, and from which we can measure the pressure at any point in the stroke, or the average pressure for the whole stroke.

The indicator is simply a small cylinder attached to an opening in the engine cylinder and containing a miniature piston. Attached to this piston is a pointer and the piston is held down to the bottom of its cylinder by a coil spring. Any pressure in the engine cylinder will enter the indicator cylinder and force its piston to rise against the pressure of the spring, the height to which it will rise depending on how heavy the spring is. As the pressure in the engine cylinder increases or decreases the indicator piston will rise or fall and, if the pointer attached to the piston is held against a piece of paper, it will trace a vertical line, the height of which will give a measure of the maximum pressure that occurred in the cylinder. If we know how many pounds pressure are required to compress the spring one inch, we can measure by the length of this line the pressure in the cylinder. Now if the paper is placed on a drum and the drum is revolved at a rate of speed proportional to the speed of the engine piston, the pointer will trace a curve on the paper. Considering only the expansion stroke, we will have a curve like the one in Fig. 1 and we can measure from it the pressure that existed in the cylinder at any point in the stroke. A more detailed explanation of the indicator, together with consideration of the complete diagram and the manner in which it is used, will be taken up further on.

CYCLES AND THE MEANING OF CYCLE PROCESSES

We have seen that work is done by introducing oil into a cylinder, burning the oil to form a gas and heat the gas during formation, forcing a piston from one end of the cylinder to the other by the expansive force of the gas, and releasing the expanded gas from the cylinder. Each of these processes we call a phase. Now if an operation is performed by causing a fluid to go through a complete set of phases, this set of phases constitutes a cycle. In the oil engine the phases of fuel combustion, expansion of gases, release and expulsion of gases, filling cylinder with air and compression of air, form a complete cycle and the operation of the engine consists of continued repetitions of this cycle. The operation of any kind of engine involves this continued repetition of some sort of cycle, although the phases that make up the cycle differ in different types of engines.

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In the case of the steam engine, for instance, some of the phases are carried out outside of the engine itself. The phase in which water is converted into an expansive, gaseous vapor by the addition of heat occurs in a boiler which may be quite remote from the engine. This indicates the principal difference between the oil engine and the steam engine; in the oil engine all of the phases of the cycle occur within the engine cylinder.

The detailed analysis of heat cycles is a theoretical study with which we are not concerned here but it is only by this study that the design and construction of practical engines have been made possible. There are a number of different cycles that have been used in the operation of oil engines but practically all have been eliminated from every day engine practice except two, the Otto cycle and the Diesel cycle, and it is with these two that we are concerned. These two cycles are named after the two engineers who invented the types of engines using them in their operation.

THE OTTO CYCLE

The Otto cycle is the one on which all gasoline engines operate and it is being more and more widely used in connection with oil engines, especially in the small sizes. It involves combustion of the fuel at constant volume and by reference to the explanation of constant volume combustion it is seen that this requires that all of the fuel be burned practically instantaneously, before the moving piston has had time to increase the cylinder volume.

A picture of what occurs in this cycle can be obtained by drawing a diagram by the method of curve plotting previ-

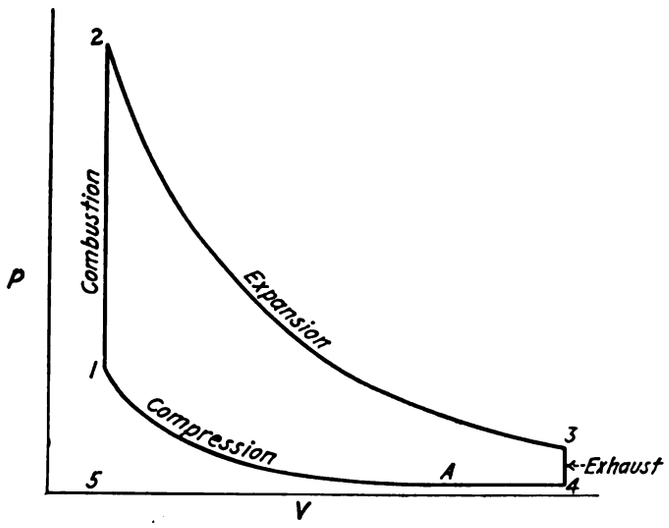

Fig. 2.—Otto Cycle

ously explained. In Fig. 2 the vertical scale represents pressure and the horizontal scale represents volume. The diagram thus obtained is commonly referred to as the PV diagram and it is the universal practice in engineering work to use the scales in this way.

Starting with a full cylinder, compression occurs as the cylinder volume is reduced and the pressure rises, as shown by the line A, until point 1 is reached, when ignition occurs and combustion takes place very rapidly, practically in the form of an explosion, before the piston has had time to start on its return stroke. This causes the pressure to rise in a straight line to the point 2. It is seen that this is what has been explained as "combustion at constant volume," and is characteristic of the Otto cycle. Expansion then occurs and as the cylinder volume increases the pressure falls until point 3 is reached, when exhaust occurs and the pressure drops rapidly to join the compression line at point 4 and the cycle is complete. In actual practice this cycle, when carried out in a real engine, varies somewhat from this theoretical picture.

THE DIESEL CYCLE

The Diesel cycle consists of the same number of phases as the Otto but these phases are carried out somewhat differently.

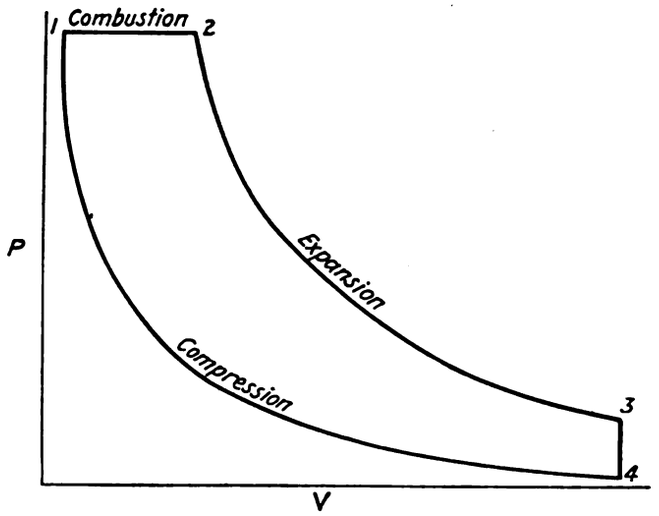

Fig. 3.—Diesel Cycle

Referring to Fig. 3 we see that compression occurs, as in the Otto cycle, but this compression is carried to a higher pressure. At the point 1 ignition of the fuel occurs and the piston starts on its return stroke. The rapidly increasing cylinder volume caused by the movement of the piston while the fuel is burning prevents the pressure from rising as a result of expansion of the gas, so we have "combustion at constant pressure." This is characteristic of the Diesel cycle and is the principal difference between it and the Otto. At point 2 combustion of fuel is completed and expansion begins. As expansion proceeds the pressure drops until point 3 is reached, when the gases are exhausted to the atmosphere and the pressure line drops to join the compression line at point 4 and the cycle is completed. As in the case of the Otto cycle, this series of events is somewhat modified in the real engine.

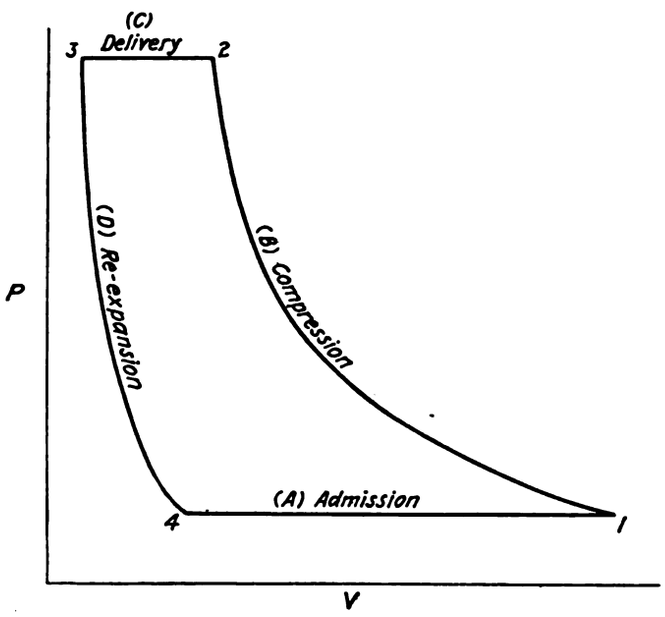

Fig. 4.—Air Compression Cycle

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AIR COMPRESSION CYCLE

The air compressor is a very necessary adjunct to most oil engines and in the air compressor cylinders we carry out a cycle the phases of which are different from the phases of the cycles just described as occurring within the engine cylinders. In the air compressor cylinders we get the cycle shown in Fig. 4. Phase (A) is admission of air at constant pressure to point 1, where phase (B), or compression, starts. As the volume decreases the pressure increases until point 2 is reached then phase (C), delivery at constant pressure, occurs, the air being discharged into a tank or reservoir. When the piston has reached the end of its stroke at point 3, phase (D), re-expansion, starts. This phase is the result of the fact that an air compressor cylinder must have some clearance between the piston and the cylinder head and at the end of the stroke this clearance space and the valve passages are filled with air at delivery pressure. When the piston makes its return stroke and increases the cylinder volume, this air re-expands and phase (D) continues to point 4, where admission of air occurs and the cycle is completed. It is evident here that there is always some air in the air compressor cylinder on which work is done in order to compress it but which cannot be delivered to the receiver or tank. All this work is not lost, however, for when re-expansion occurs on the return stroke this air does work on the piston and helps to force it to the other end of the cylinder.

(*To be continued*)

Great Lakes Shipowners Develop Model Welfare Plan

Over 26,000 Seamen and Officers Derive Benefits from Welfare Work of Lake Carriers' Association

By George A. Marr*

THE Welfare Plan of the Lake Carriers' Association was not created in an hour of haste to meet an emergency. Eight years before it became effective the project had been laid out in minute detail but on the eve of launching, labor officials made a proposition to undertake the essential features of administration. The vessel owners somewhat reluctantly gave the seamen's organizations full opportunity to demonstrate their efficiency in this respect. These organizations were to supply the unlicensed men, leaving, however, the system of individual contracts to the officers; they were to deal justly with the men on shipboard in case of injury, disability or death and in a general way promote the well-being of the men both ashore and on the vessels.

From the very beginning this service was unsatisfactory all around. There was such wholesale dictating of the employment and the service that the officers lost control of discipline on shipboard. The response to officers' calls for men to complete a crew was a characteristic failure, the men provided not having been selected with regard to fitness for the berth and in times of stress not provided at all. Nothing was done to promote the comfort of the men at any time or place and there was bitter complaint on the part of these men and their dependents of the administration of the benefit features.

As year after year passed, and the situation for the employer and employed became increasingly intolerable, the members of the Lake Carriers' Association, representing 90 percent of the gross freight tonnage on the Great Lakes, in 1908, returned to the contemplated project of 1902 and endorsed it without a dissenting vote. Thus the association was one of the first organizations representing industry of national importance to declare for the open shop. In a nutshell the declaration of principle was embodied in the following:

"That it should be the aim of the executive committee, in the means they shall adopt, to recognize a fair and equitable rate of wages, to insist upon such regulations as shall promote the comfort and well-being of the employees, shall put the discipline of the ship in the hands of her executive officers and, tendering liberal appropriate wages and conditions, require in response appropriate, diligent and prompt service from the members of the crew."

*Secretary and treasurer, Lake Carriers' Association, Cleveland, Ohio.

The Welfare Plan became effective at the opening of navigation in 1909. What has been done for the men by Welfare Plan activities such as savings, safety first, education, sanitation and death benefits will be stated later.

NEARLY TEN THOUSAND REGISTER THE FIRST YEAR

In the first year registrations totaled 9,752. At that time the membership included package freighters, a large amount of wooden craft and a numerous collection of tugs, representing in the aggregate 2,017,273 gross registered tons. At the end of 1923 registrations for the year in good standing totaled 26,305 divided as follows:

Masters	309
Mates	730
Chief engineers	350
Assistant engineers	672
Stewards, able seamen, oilers and firemen	10,384
Galley help, ordinary seamen and coal passers	13,860

The present membership consists of 404 steel steamers and 22 steel barges, all of them cargo carriers and representing 2,175,842 gross registered tons. With but a single exception, the strike of 1909, when the supreme effort of the labor leaders was made to break the Welfare Plan, relations with labor have been cordial and in comparison with the experiences of other large industries profoundly tranquil throughout the past decade.

The Lake Carriers' Association passed through the entire war period and through the still more trying after-the-war period of unrest without labor difficulty. The answer to this remarkable record is to be found in the fact that the vessel owners kept faith with the men in regard to its declaration of 1908. While the great work has been under the ever scrutinizing eye of the executive committee, the actual work has been carried on by what is known as the Welfare Plan Committee, consisting of nine active vessel managers and each of the various welfare features is under the supervision of a sub-committee of three of these members. Thus every activity of the Welfare Plan is handled without delay or neglect.

THE ASSEMBLY HALLS

The first act of the Lake Carriers' Association, following the adoption of the Welfare Plan, was to establish respectable assembly halls in the various ports. Locations accessible

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to the docks were made subservient to quarters elsewhere that were light and of cheerful aspect. The rooms are models of cleanliness and convenience throughout the year, there is an absence of heavy atmosphere, discipline is maintained without having to resort to strong measures. The rooms are plentifully supplied with daily and weekly publications and magazines. There are tables for cards and other games. Gambling is not tolerated. Writing material is always at hand, hundreds of the men receiving their mail at the rooms the year round. Many of the rooms have shower baths and all are so supplied that men may have individual towels and soap. Also there is the free privilege to check baggage. During the winter season the rooms are warm, cheerful and airy and in addition to the mentioned recreations there is a Victrola in every room with a circulating library of the latest records.

It is plain to be seen, therefore, that the assembly halls are not employment offices but are places of *rendezvous* for the men during all the year. The value of these rooms to the men during cold or wet weather is obvious. They are particularly appealing in the spring. As a general rule, sailors return to the lake country in March when the weather is raw and rough. Instead of standing on street corners and in hallways, the comfortable rooms and their conveniences for whiling away idle hours awaiting the opening of navigation are at their disposal without regard to their affiliation or non-affiliation with any organization.

There are fifteen assembly halls located in the following named cities: Buffalo, Erie, Conneaut, Ashtabula, Fairport, Cleveland, Lorain, Toledo, Detroit, Gary, South Chicago, Chicago, Milwaukee, Ashland and Duluth. Each of these rooms is in charge of a commissioner, with as many assistants as the importance of the port requires. The commissioner, however, is not an employment agent. When men are required for a vessel an officer, either personally or by telephone, states his requirements and the commissioner fills the order only so far as to give men an identification card and this is given without regard to creed, nationality or affiliation. Upon arrival at the boat the vessel officer may engage or reject the men sent. In cases where men are rejected the process is repeated until the officer is satisfied. It is a rare case that a vessel is held in port for want of a full crew, though there are times when the commissioners go under heavy pressure. In times of labor scarcity they have worked 24 hours in a stretch and for hours have scoured the streets and rooming houses for available material.

Club Rooms for Licensed Officers

In addition to the assembly halls for able and ordinary seamen the Lake Carriers' Association maintains throughout the year club rooms for licensed officers at Buffalo, Cleveland, Detroit, Algonac, Marine City and Port Huron. Each room is typically equipped in the fashion of a club and in the winter season is largely patronized. Billiard, pool and cribbage tournaments are a feature during daylight hours while in the evening card parties and dances for the families and friends of vessel officers are of frequent occurrence.

System of Registration

Coincident with the establishing of the Welfare Plan in 1909, the association issued a discharge book to each man registering as able or ordinary seaman and this system has been in constant use save for a brief space during the world war period. The discharge book is nothing more than a service record contained between covers instead of in loose leaf form and subject to loss. It is held in high esteem by the rank and file who look upon it from its true point of value as a recommendation for steady service. In hundreds of instances it has proved of timely aid for purposes of identification. Of greatest value, however, is the instant acceptance of the service records contained in it by naturalization examiners or by the United States Steamboat Inspection Service when the holder of the book comes up for examination for license.

Registration Records Are Invaluable

The registering in the Welfare Plan of practically all the seamen who have sailed the lakes in American vessels since 1909 has given to the Lake Carriers' Association such a complete and invaluable record that identification of those men can readily be made.

The signal use to which these records may be put was strikingly displayed after the great storm of November, 1913, when fourteen vessels foundered and 235 lives were lost. Six of these steel steamers with 150 men aboard were enrolled in the membership of the Lake Carriers' Association. Nowhere but in the offices of the association did there exist a record showing a description of the men with personal identification marks, but the Lake Carriers' records were so complete in detail that as the bodies were washed up on the shores of Lake Huron and recovered by a committee sent there for that purpose it was possible positively to identify the bodies of 148. The names of the remaining two were known but owing to the condition of the bodies individual identification was impossible. Thus it was possible immediately to communicate with relatives as to the disposition of the remains. Moreover, this system of registration enabled the association to advise thousands of inquirers as to whether or not sailors inquired about were on any of the lost ships. It was a tremendous relief to many to learn from the association the exact ship they were on with assurance of their safety, if it so happened they were not on the ill-fated vessels. Furthermore, when the people of Cleveland, by popular subscription, raised a fund of $75,000 for the relief of widows, orphans and other dependents of the victims of the storm the registrations were the only records upon which the relief committee could rely in making the distribution. The registration records therefore accounted for the payment of $1,333 to each widow, one-third of that sum to orphans and substantial provision to aged parents.

Storms causing such widespread devastation do not occur on the lakes once in a lifetime. Since 1913 only four Lake Carriers' vessels have been lost by shipwreck and in each of these cases identification of the dead was easily possible. The registration records, always kept up to the minute, are available for instant use in case of disaster.

Accident and Death Benefits

The fee for membership in the Welfare Plan is $1.00 for either able or ordinary seaman which gives the privileges of the assembly halls and eligibility to attend the free schools during the closed season. But registration also provides for a death benefit and a total disablement benefit for accidents occurring on Lake Carriers' vessels which involve either of these misfortunes.

The death or the total disablement benefit amounts to $75 for ordinary seamen; $100 for able seaman; $150 for stewards, second mates and second assistant engineers; $250 for first mates and first assistant engineers; $400 for chief engineers and $500 for masters. The payment is made without impairment of the sailor's rights in future litigation. The object, as a matter of fact, is to furnish ready means to the sailor himself in case he becomes totally disabled and in case of fatal injury ready means for the beneficiary he has named in his registration and which generally proves to be his wife, father, mother, sister or brother. A "friend" is not often named. The object being to avoid pecuniary embarrassment in a trying hour, the benefit is immediately paid and usually before a request can be made for it.

Since 1909 the Lake Carriers' Association has paid 466 death benefits involving $62,005. Although the death benefit applies when injuries have been sustained, no year passes

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by but what a number of registered men die from natural causes. It frequently happens that these unfortunates pass on without having left means to provide for burial, and without known relatives to provide for such. In cases of this kind the Lake Carriers' Association furnishes respectable burial in a private grave for members of the Welfare Plan.

EDUCATING SEAMEN FOR ORIGINAL LICENSES

For some time the Pittsburgh Steamship Company, which operates more than 75 large ore carriers, conducted, during the closed season, a school in marine engineering for the benefit of the oilers on its vessels who by service were eligible for engineer's license, and for officers with a limited license to obtain a raise of grade. In the winter of 1915 the Lake Carriers' Association took over this school and made it an educational feature of the Welfare Plan. The scope was broadened by throwing the school open to the men in all the fleets in the membership. At the same time a school in navigation was opened at Cleveland and, inasmuch as a large number of lake sailors live along the river between Detroit and Port Huron, schools in engineering and navigation were opened at Marine City, Michigan. These men are thus saved the expense entailed in leaving home.

The four schools have been continued every winter since 1915. From schools that originally contained limited equipment they now have everything in the way of models, libraries, etc., that the student in either navigation or engineering may desire. The classes open immediately after the new year and the course of instruction and examination before the steamboat inspectors involves from 10 to 12 weeks' time. Commodious quarters with facilities best suited for the work in hand are provided. The schools are free and although the men bear their personal expenses, there is a student's aid fund, created by several friendly interests, which makes it possible for a student who, through unforeseen circumstances might otherwise be deprived completion of his course, to receive sufficient advances to complete the work and become an officer.

The instructors in these schools are the best that the Lake Carriers' Association has been able to obtain. The director of the marine engineering class at Cleveland is David Gaehr, graduate of engineering from Cornell and himself the holder of a chief engineer's license good in all the waters of the world. His assistants—the number depending on the size of the class in hand—usually are his former students and now assistant engineers in the fleet. The engineering class at Marine City, long conducted by Harry Stone, a veteran chief engineer, and famous throughout the lake region for half a century as an instructor, is now under the direction of Ralph Britz, also an engineer in the lake fleet. The instructors in navigation are Captain John C. Murray, master of the bulk freighter *Wm. E. Corey,* at Cleveland, and Captain N. M. Hetherington, master of the steamer *Neptune,* at Marine City. It will thus be seen that in addition to their natural ability the instructors are able to impart to their students the vast fund of knowledge gained from actual experience as lake engineers or navigators.

During the winter recently ended the schools of the Lake Carriers' Association turned out 54 new marine engineers and 41 pilots who are eligible to accept appointments as second mates. Nearly all of these new licensees received appointments as vessel officers when the schools closed. Indeed, there are many who, having left the ships at the close of 1923 as oilers or wheelsmen, are back on those very boats this season as assistant engineers or second mates. They have not only the pride that promotion carries, but a substantial increase in earning power and a short road through which to reach the highest position the lake service affords.

During the world war when the supply of licensed officers was not equal to the demand the association also conducted schools at Milwaukee and Duluth. All told the schools have been in existence nine years and the output totals 316 men with original licenses as marine engineers and 220 licensed pilots. In addition 59 have been aided to obtain a raise of grade to first assistant engineers and 87 others have been made chief engineers; 33 have won their master's papers. To a large extent these officers continue in the service of the lake fleet. Some temporarily went into the ocean service for the novelty and the experience, but, with hardly an exception, have returned to the service of a lake bulk freighter. Significant of the progress that is being made by the young men who only a few years ago came to the Lake Carriers' school for an original license it may be added that last winter 14 graduates from the classes between 1916 and 1920 came back and earned their chief's license. One of these, licensed for the first time in 1921, was awarded an unlimited license as chief engineer. He is 25 years old. Practically the same ratio of progress is to be found among the navigators notwithstanding that promotion on the deck of a lake vessel is not as rapid as in the engine department. One graduate from the class of 1919 and another from the class of 1921 may be found in command of vessels while there are many who have attained to the berth of first mate.

SANITATION

The sub-committee on sanitation made such a thorough and effective campaign several years ago that sanitary conditions aboard the vessels and in the matter of food, milk and drinking water now require only casual inspection. So effective has been the work along these lines that a marked reduction has occurred in the percentage of sickness aboard the vessels. Cases of typhoid fever are not numerous and when a case has been found investigation proved that contaminated water had been drunk ashore, or else the victim had violated rules and drunk water from overboard sources.

SAVINGS AND SAFETY FIRST

As these subjects were dealt with in detail in recent issues of MARINE ENGINEERING AND SHIPPING AGE only passing comment need be given. In order to conserve the earnings of the seamen—to prevent needless expenditure and of being robbed—the Lake Carriers' Association in 1911 established the savings plan by which the seaman could deposit his earnings in a trust company through the medium of drafts on the owner made out by the master. More than 20,000 seamen have taken advantage of this opportunity and total deposits have exceeded six million dollars. As an evidence of what this simple method of saving means it may be mentioned that last year a second trust company entered into this arrangement. Although only four lake fleets and numbering about 37 vessels enlisted with this second trust company, the season's deposits amounted to $283,000. The interesting part is to be found in the fact that when navigation opened a few weeks ago $75,000 remained on deposit.

Time was when personal injuries on deck, in the engine room and fire hold were numerous and generally serious in nature. The difficulty of teaching safety-first methods to men on ships almost constantly at sea was hard to overcome. The problem was finally solved by an ingenious project worked out by the sub-committee of the Welfare Plan on safety. This provided for a ship safety committee to consist of six members of the crew, three to be appointed by the master from the deck department and three by the chief engineer from the crew working below. Although their work in this connection was to safeguard themselves and their shipmates from bodily harm each was to be paid for the time involved and to receive a bonus at the end of the season provided no injury sufficient to cause the injured to leave his ship occurred during the period of navigation. The scheme has worked like a charm. The committees work with energy and enthusiasm, personal injuries have shown a marked decline and fatal injuries have been greatly reduced.

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The activities of the Welfare Plan as have been here enumerated cover fixed subjects. The committee in charge endeavors to cover with facility any matters affecting the comfort and well-being of the men who man the lake ships. Events of importance constantly arise to command the close attention of the committee, which consistently adopts a course that best serves the sailor. Three years ago when the American Merchant Marine Library Association proposed establishing free libraries on the lake freighters the committee furnished the pecuniary aid to make the work possible and this aid has been continued annually. The library of about 30,000 volumes is located at the Sault Ste. Marie canals where the vessels are accessibly served as they pass up or down and last year service was rendered 1,554 ships, a total of 1,907 libraries, or 47,650 books, having been circulated.

In times of stress the Welfare Plan Committee is confronted with a multiplicity of big events that require prolonged effort to bring to successful conclusion. In this connection it may be pointed out that during the war the committee assumed the heavy task of interesting an army of 25,000 sailors in the support of national needs. Through the campaigns made from time to time the lake ship subscriptions and contributions included $445,250 subscribed to the third Liberty Loan; $662,900 subscribed to the fourth Liberty Loan; $414,753 subscribed to war savings stamps; $79,623.99 contributed to the Victory Chest. Contributions to minor events amounting to $7,501.87 made a total of $1,610,028.86 which the committee succeeded in collecting from the men of the lake vessels in support of the national emergency.

Applying Chemistry to Marine Engineering Problems

Corrosion, Electrolysis, Combustion Products Are Factors which Must Be Considered in Successfully Operating Steamships

By C. A. McAllister

TO the average sea-going engineer the science of chemistry is not alone mysterious, because he knows but little about it, but in a general way it has to be the "goat" for many accidents and deteriorations to the vital parts of marine machinery. The technically trained marine engineer is not much better off, for, as in the writer's own case, he may have had a smattering of chemistry in his college course but remain sometimes densely ignorant of what are merely underlying principles governing the application of this great science.

At the first blush it would seem that chemical science is far afield from a direct connection to the designing and operating of marine machinery. Yet, is that the fact? Are there any greater problems to solve aboard ship than combustion, corrosion and electrolytic action? The chemist tells us that combustion is merely the proper combinations of carbon, oxygen, hydrogen and nitrogen, and, boiled right down to hard facts, that is about all there is to it. How few of us there are that can write the simple chemical formulæ for these various combinations, and their effects on proper combustion. We speak glibly of maintaining the proper percentage of CO_2, but how few of us are familiar with the whys and wherefors!

Corrosion Aboard Ship

I remember reading in a text-book on chemistry, many years ago, that "Corrosion is but slow combustion." Oxygen was described in that elementary treatise as a very greedy element and that it not only sustained all life, but eventually destroyed it; that from the time we began to live we also began to die, all due to the greediness of that chemical element, etc., etc. So applied to ship propulsion, we know that while it is absolutely essential for combustion and the consequent propulsion of our ships, it is at the same time doing its darndest to destroy them. We can subscribe to the fact that it *is* a very greedy element—greedy to be married to carbon and equally as greedy to unite with iron, in fact a regular Mormon among the basic elements.

While it is an enemy to the shipowner, it is a friend to the shipbuilder. Conceivably without its greedy desire to unite with iron, ships might last forever and need no repairs, except those caused by accidents. To avoid its ravages, requires constant attention on the part of the ship scaler and the ship painter, not to mention the repair man who has to renew rusted out plates and shapes, and ferrous materials of all kinds. To prevent corrosion or to avoid it we have various mixtures of paints and other compounds, or else resort to materials which refuse to listen to the soft blandishments of the ever-present oxygen. We know that the best preventative is the absolute barrier of the commingling of the oxygen and iron, or its diluted descendant, steel. Most of the preventatives would be defined in medical science as "quackery," and not based on scientific deductions from a complete knowledge of chemistry. We know that corrosion is greater in steel than in iron, that the union of oxygen and iron is greatly quickened by the addition of heat, and that steel corrodes faster in salt water than in fresh water. But how much scientific attention has been paid by the marine engineer to obviate these well known conditions? For example, what degree of acceleration of corrosion is brought about by various increases of heat to the surrounding media?

Electrolytic Action on Ship Structures

Coming to the third chemical bugaboo, the arch conspirator, electrolysis, we are prone to throw up our hands, and look upon his depredations as "acts of the enemy," against which there is no remedy, except the repair shop. There has been, ever since metals played such an important part in ship construction, an air of mysticism surrounding electrolytic action on the various parts of ships. Indeed at times it has so overpowered the minds of people who design and operate ships, that, in one instance at least, a brand new ship was utterly destroyed a year after she was completed, by a failure to take into account the effect of electrolytic action on the component parts of the hull.

Even today, there are men eminent in the profession, who apparently ignore the basic principles of electro-chemistry. The primary lessons in electricity teach us that a current will be set up in a battery containing copper and zinc elements immersed in an acid medium. This phenomenon is always accompanied by the disintegration of the zinc or negative element. Yet there are hundreds of our large ships in service today fitted with propellers having bronze blades and cast iron or cast steel hubs. The ferrous metals here take the negative side of the electrical argument, and the sea water furnishes the acid medium. If there could be devised any

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unholier alliance for underwater sea service, I do not know what it could be. During the war period, this combination was possibly necessary, on account of the difficulty in securing large bronze castings, but today there is no such excuse. Many engineers will defend this method of built-up propellers, but the writer has always maintained that the combination will eventually prove disastrous. It is so easy to neglect the fitting of zinc protection, or to improperly fit it, that very frequently now we hear of those vessels losing blades at sea from no apparent cause.

That is the claim made by many operating engineers, but to my mind the cause is very apparent. The electrolytic action has insidiously disintegrated the iron from the ferrous castings, and from the studs as well. Many samples from propeller hubs exist, which from outward appearances are sound, but can quite easily be cut by an ordinary pocket knife. The reason is that nothing but a pure carbon structure remains. It is no doubt desirous, and will continue to be, to use bronze for propellers, owing to its many advantages, but unless constant care is taken to eliminate the iron or steel structure from their vicinity, it will be well to watch out for disintegration. There is now on the market a specially prepared paint, which seems to be a successful insulating material to prevent the ravages of electrolysis. It is claimed that the use of this material makes it unnecessary to fit the expensive zinc plates around the stern work. In any event it seems to be the right idea when using bronze propellers, and it is in use on quite a number of vessels, notably the huge *Majestic*, with her four bronze propellers.

Condenser Failures Traceable to Electrolysis

It has been truthfully stated that about one-half of all voyage repairs are directly traceable to condenser troubles. Here again we go against elementary chemical problems. The juxtaposition of bronze condenser tubes and cast iron or wrought steel condenser shells starts trouble. Usually the condenser tubes fail and leak, on account of electrolytic action. Salt water gets into the boilers and then all kinds of ailments develop, even affecting indirectly the turbines and cylinders of the main engines. The always tight condenser is still noticeable by its absence, although constant progress is being made to solve that problem. If we can have pure water in the main boilers at all times, going to sea would lose much of its terrors for the marine engineer. Since the earliest days, all manner of treatments have been devised to insure that only pure water will enter the boiler, but most of them have been based on quackery and not science.

The watertube boiler is rapidly coming into its own, and the days of the Scotch boiler are numbered; hence it behooves us to pay ever increasing attention to the quality of the water used. The old days of testing by salinometer, and dumping in everything from soda ash to potato peelings and kerosene are gone. The chemist has helped us to overcome the problem. We all know that carbonate of soda, whether in the form of soda ash, sal soda, washing soda, caustic soda, lime, boiler compound or whatever else it may be called is the chemically proper material to overcome acidity in boiler water, that property which causes most of our troubles.

Chemists have prepared testing kits, by means of which any ordinary person can determine with reasonable accuracy the amount of chlorine content in the boiler water. The "thirty seconds" of the old salinometer are now replaced by "grains per gallon," in boiler room conversation. Salt in the water, which cannot even be detected by taste, may exist as high as 40 grains, sufficient to coat the tubes of boilers in less than a day's steaming. All right, get out the bottles the chemist has provided with the testing kit and determine just how many grains there are and then find out, from a table, how much soda ash to put in the feed tank per ton of water used. In the old days the formula was to use from a handful to a bucketful per watch, according to the whims of the chief, regardless of what was scientifically necessary.

What is needed in all marine engineers' bookshelves is an elementary treatise on chemistry, written in a readable and understandable manner and applicable to ship propulsion and maintenance only. Who will write it?

Aluminium Alloy Pistons for Diesel Engines

By Major Johnstone-Taylor

IN a communication to the British Institution of Naval Architects Engineer Commander Beeman has some instructive comments to make upon aluminum alloy pistons for Diesel engines. In view of the fact that such pistons are almost exclusively employed on aircraft engines and now largely in motor car engines it is not surprising to find that in efforts to reduce the inertia effects attendant upon high piston speed aluminium alloy pistons are being seriously considered for Diesel engines.

Composition of Material

Pistons of this material (see table) have been successfully cast up to 25 inches in diameter and with proper heat treatment a tensile strength of 12 tons with an elongation of 4 percent in 2 inches may be relied upon and no serious defect from shrinkage has become apparent. Commander Beeman's experiments relate to 5 engines of which the following particulars refer to three, the two others being of secondary importance.

	Type	Revolutions per Minute	Cylinder Diameter, Inches	Stroke, Inches	Piston Speed Feet per Minute
Engine "A"	4 stroke, solid injection	380	14.5	15	950
Engine "B"	4 stroke, air injection	390	20	20	1,300
Engine "C"	2 stroke, air injection	360	14.35	28.34	850

Piston Material: Aluminium, 93.5 percent; copper, 3.0 percent; nickel, 1.5 percent; magnesium, 1.0 percent; iron, 0.5 percent; silicon, 0.5 percent.

Results of Experimental Working

Engine "A" is an experimental engine built several years back. Fitted with an aluminium piston subject to a mean pressure of 150 pounds per square inch, the material proved suitable although the design of the piston was found to be at fault.

The piston of engine "B," also an experimental unit, showed up, in common with engine "A," certain defects in the bushes.

The wrist pin bushes are gripped between the two portions of the piston and to anticipate differential expansion it has been usual to arrange that when the two portions are screwed together—with the wrist pin bushes removed—the vertical diameter of the recesses should be about 5/1000 inch smaller than the bush diameter. Thus with the bushes fitted in place and the two piston halves abutting, a compressive stress is set up in both pistons and bushes. Under heated conditions it is estimated that the bushes should never be slack in the piston.

A peculiar type of hammering has been found, however, to take place on the outer surface of the bushes in the regions under load which leads to distinct depression there although no adjacent sign of the action is discernable on the adjacent portion of the aluminium piston itself. The exact cause of this hammering action has not so far been explained. It should be noted that engine "A" had an uncooled piston and engine "B" a cooled one, both pistons being in two portions divided at the wrist pin axis.

The defect outlined has been remedied by an alternative material for the bushes and also by an alternative design of

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bush having square backs. Otherwise the pistons in both engines proved satisfactory.

Engine "C" is of the Doxford opposed piston type involving pistons which are virtually ring carriers attached to the external crossheads by means of steel rods. Originally fitted with cast iron pistons, this engine was then fitted with aluminium pistons having steel crowns partially water cooled. These were not a great success, considerable burning and erosion of the crowns taking place.

After these were replaced by all-aluminium pistons, the average mean pressure being 140 to 160 pounds at 300 revolutions per minute, there were no signs of burning, although the studs screwed into the aluminium for the attachment of the rods worked loose. In this connection it should be noted that when subject to overheating an aluminium piston becomes soft. This may be regarded in the light of an advantage in that, if seizure should occur (the clearance allowed with aluminium pistons being often inadequate), the cylinder liner practically escapes damage. At the same time it may also be expected from this property of the alloy that, if other materials are fitted in association with the piston, some effects of differential expansion would be observed. The slackening of the steel studs screwed into the top portion of the piston for the attachment of the lower portion has been experienced. This was attributed originally to relative expansion effect but it has since been demonstrated that this is not the correct explanation and that actually the threads in the alloy yield. With care this effect may be minimized, but it has been judged desirable in larger pistons to provide bolts and nuts as an alternative attachment.

Development of the Airship with Special Reference to Transport*

By Commander C. D. Burney, C.M.G.

IT is possible to classify roughly under four main headings the problems which the aeronautical engineer has to face:

(1) The means of flotation which he shall adopt;
(2) The provision of a structure which, while adapted to utilize the means of flotation for the purpose of lifting weight, is also suitable for propulsion through the air at high speeds;
(3) The means of propulsion itself;
(4) The handling and operation of the completed airship on a commercially economic basis.

The differences between water-borne, particularly submarine, and air-borne vessels are essentially *quantitative* rather than qualitative, but the quantitative differences are so great as to introduce immense difficulties before a successful air-borne vessel can be produced.

The gross lift per unit of displacement at the service of the naval architect is nearly one thousand times greater than that at the service of the aeronautical engineer.

Hydrogen has remained for many years the only suitable means of obtaining the required displacement. An airship filled with helium has a lift 7 percent *less* than one of equal displacement filled with hydrogen. This loss of lift would mean a loss in potential earning capacity of *no less than* £84,000 *per annum* in airships of the size which we shall use on the Indian route, for it should be noted that the use of helium does not result in a corresponding decrease in the structural or deadweight of the ship. Apart, however, from the disadvantage attached to its higher specific weight the use of helium in airships is necessarily limited. We can easily show that even when allowance has been made for the reduction in cost resulting from supply in great quantity, the cost of the production and transport of helium would alone be so great as to render any commercial scheme an impossibility.

* From a paper read at the spring meetings of the sixty-fifth session of the Institution of Naval Architects, London, April 10, 1924.

It is now generally admitted that in the larger sizes of ship the rigid principle is the only practicable one that has yet been devised. Briefly the German system is to construct the rigid hull by means of a series of transverse diaphragms pitched 10 or 15 metres apart, and connected by longitudinal girders equally spaced. These girders are braced by means of diagonal wires so spaced as to form a mesh of about half a metre pitch. The gas-bag inside presses against these mesh wires, setting up a side loading on the girders, which transmit the load to the transverse frames to which their ends are anchored. The transverse frames in their turn collect the load from the girders and transmit it to the concentrated loads hung beneath them.

This system has many disadvantages, and the side loading on the longitudinal girders quickly reaches a magnitude which, in ships of sizes proposed today, becomes almost prohibitive.

Designers in England have, however, long been aware of this defect, and prolonged research has resulted in the perfection of a system for containing the gas-bag, whereby no transverse loading is imposed on the longitudinal girders.

So great are the improvements that we have made both in the analysis of applied forces and in the structure required to resist them that it is possible for us to construct a modern commercial airship in which the factors of safety under the worst possible loading conditions shall not drop below a minimum value of 4, while maintaining to the full the lightness which is necessary for commercial efficiency.

I cannot too strongly emphasize the point that in all cases it has been definitely established that the source of fire in airships, as in heavier-than-air craft, is *petrol* and not hydrogen.

Now a means is at our disposal whereby a heavy oil, such as kerosene, with high flash-point may be used on a low temperature cycle without loss of efficiency. The resulting engine has a weight of some 5 pounds per brake horsepower, and is comparable in its mechanical simplicity and reliability with the marine steam engine. Further experiments are now in hand, with still heavier oils, and I think I may confidently say that the petrol age, for the airship in particular and, indeed, for aircraft in general, has now virtually passed.

A careful analysis of running costs and earning capacity has led me to the conclusion that the smallest size of ship that can be profitably employed on commercial work must have a displacement of not less than 5 million cubic feet, giving a gross lift of approximately 150 tons. Of this 150 tons some 75 are available for lifting fuel, crew, passengers, and mail cargo, etc. These ships will have a cruising speed of 80 miles an hour, the power installation consisting of seven interchangeable units of a maximum 600 brake horsepower each.

The maximum economical length of flight is between 2,000 and 2,500 miles.

The actual route which we are planning at present is that from England to India, where our terminal station will be Bombay. This route will be flown in two portions, the halting place being at Cairo, dividing the journey roughly into London to Cairo, 2,300 miles; Cairo to Bombay, 2,400 miles.

New Automatic Time Switch

FOR the control of circuits of moderate rating, a new automatic time switch, type T-7, has been placed on the market by the General Electric Company, Schenectady, N. Y. The principal feature of the new device is the adoption of a Warren synchronous motor in place of the conventional spring-driven clock commonly employed in other types. The new switch is for use only on alternating current circuits where the frequency is properly regulated. It is rated 20 amperes, double-pole, single-throw, for use on circuits not exceeding 250 volts.

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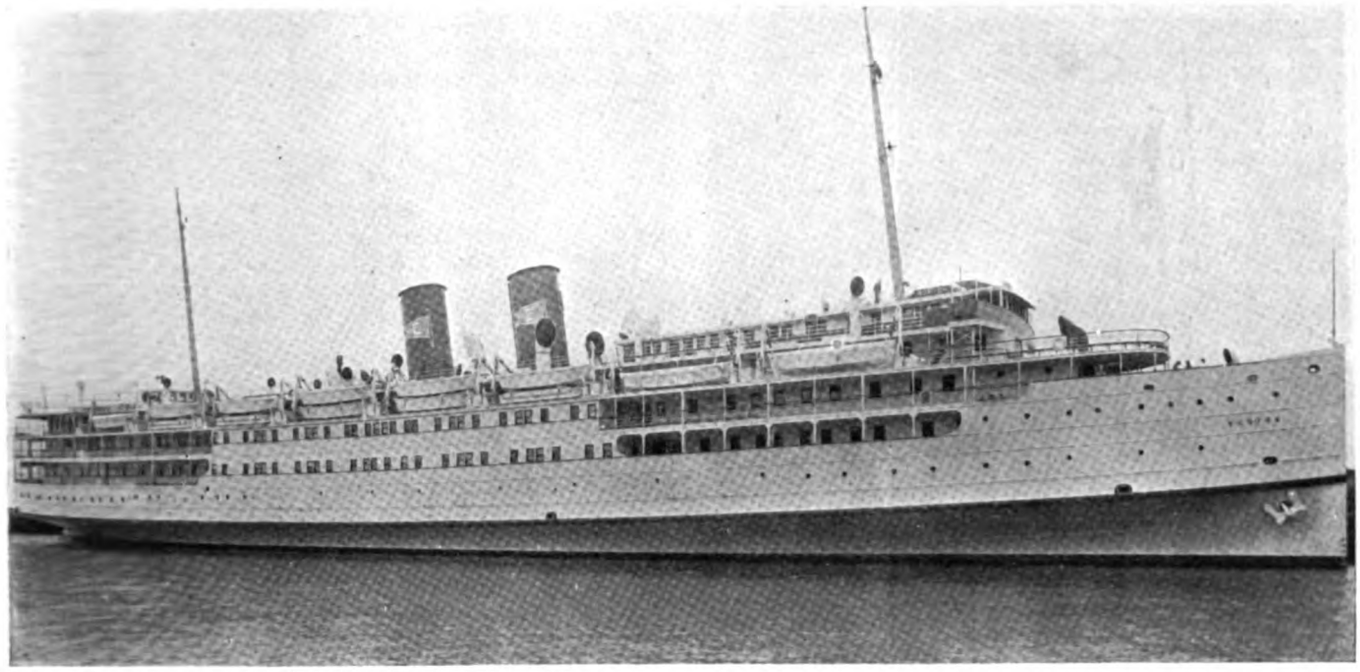

S. S. Boston, First of the Two New Express Steamers for New York-Boston Service

New Steamship Boston Goes Into Service

First of Two Express Sister Ships Placed on the New York-Boston Run by the Eastern Steamship Company

ENTERING the "all water" route between New York and Boston early in June, the S.S. *Boston,* of the Eastern Steamship Company, has already attracted most favorable comment from the traveling public as well as from naval architects and engineers who have had an opportunity to inspect the vessel.

The *Boston,* and her sister ship *New York,* now completing at the yards of the Bethlehem Shipbuilding Corporation at Sparrow's Point, Md., were designed by Mr. Theodore Ferris, of New York.

In our issue of March, 1923, an outline description and plans were published and we are now able to add photographs of the completed vessel as well as a more detailed description and plans.

Hull Construction

The general dimensions and particulars of the *Boston* and *New York* are as follows:

Length overall	402 feet 0 inches
Length, 15-foot waterline	396 feet 4 inches
Length, between perpendiculars	385 feet 0 inches
Beam, over guards	72 feet 6 inches
Beam, molded	71 feet 2 inches
Beam, at 15-foot waterline	58 feet 2 inches
Depth, molded to main deck	23 feet 9 inches
Load draft, designed	16 feet 6 inches
Load displacement	5,450 tons
Block coefficient at 16-foot 6-inch draft	0.498
Approximate weight of ship	4,650 tons
Approximate deadweight at 16-foot 6-inch draft	800 tons
Fuel oil capacity	270 tons
Gross tonnage	4,989
Net tonnage	2,703

The vessels may, in general, be described as steel, twin screw passenger steamers with sponsoned hull and four deck, steel and wood superstructure.

The steel hull is constructed on the transverse system with a complete double bottom and seven transverse watertight bulkheads, extending up to the main deck.

As these vessels have to navigate the Cape Cod canal, a somewhat unique feature, to guard against damage to the bilges from grounding, has been introduced. Throughout the central portion of the hull, the bilges are protected, or backed up, by longitudinal watertight compartments formed, in the boiler rooms, by the deep fuel tanks abreast the boilers, in the engine room by dry-tanks extending up 10 feet 6 inches above the base line, in the hold forward of the boiler rooms by extending the double bottom up the sides and in the after hold by the longitudinal bulkheads forming the shaft alley.

The main deck and the lower deck aft of the engine room are completely plated.

The sides of the superstructure, between the main and hurricane decks, are of light steel plate, all fore and aft; and between the hurricane and saloon decks, the sides are plated amidships, and for about 60 feet aft of the stem.

A cast steel spectacle frame is fitted to take the after end of the stern tubes, and to support the outboard shafts and propellers, a V-strut, also of cast steel, is fitted on each side.

The rudder is of the balanced type, of unusually large size, and as a further aid to maneuvering the ship, the deadwood aft is cut away and the line of forefoot raised above the base line for a distance of approximately 60 feet aft of the stem. Two light steel pole masts are fitted and two funnels, the forward, a regular double smokestack and the after one, a ventilating trunk.

Passenger Accommodations

The general arrangement of the passenger accommodation is clearly indicated by the accompanying plans. Sleeping space is provided for 900 passengers, as follows:

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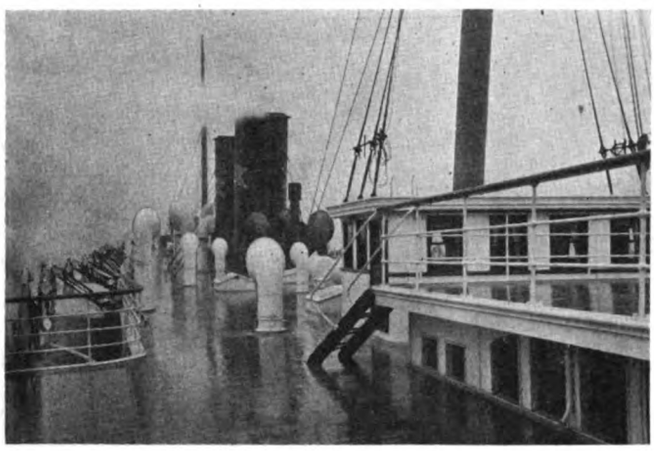
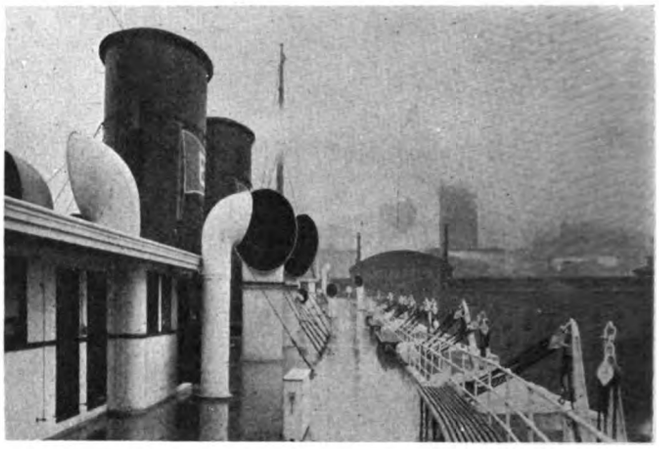
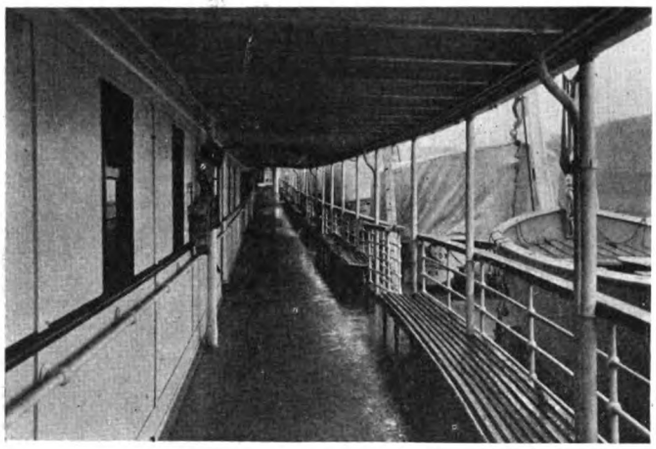


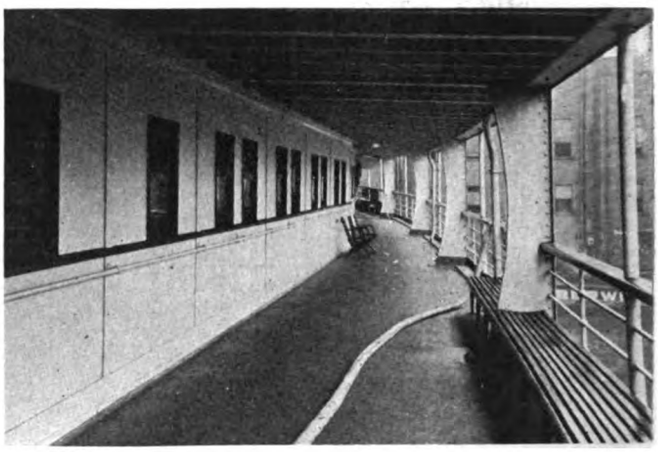
Shade Deck, Looking Forward



Shade Deck, Looking Aft



Promenade (Boat) Deck, Looking Aft



Hurricane Deck, Looking Aft

		Passengers
De Luxe rooms, with bath	14	28
Special rooms, with toilet	64	128
Regular rooms	267	534
Total staterooms	345	
Total passengers in rooms		690
Berth travel, men		160
Berth travel, women		50
Total passengers		900
Crew, deck department	46	
Crew, engine department	27	
Crew, steward's department	95	
Total crew		168
Total persons on board		1,068

The staterooms are very comfortably and completely fitted up in accordance with the most modern and up-to-date practice. A very noticeable feature, throughout the passenger accommodation, is the air of spaciousness given by the wide and unobstructed passageways and commodious entrances and lobbies.

Transverse fire screen bulkheads, with sliding metal doors in the passageways, are fitted throughout the passenger quarters, at each end of the machinery casings.

Vehisote and Roddiswood have been largely used in the joiner work, inside and out, with apparently very satisfactory results. The outside of the joiner houses is formed of vehisote panels, while agosote is used for forming the rounded corners of the houses. The effect of this construction is very similar in appearance to that of a steel deck house. The passageway and stateroom bulkheads are of Roddiswood throughout, the outer layers being of hard wood, finished to suit the scheme of decoration of the various spaces.

While there is little elaborate or ornate decoration in the public rooms, the general scheme of color and finish has been carried out in excellent taste and is eminently satisfactory and pleasing to the eye—to our mind, infinitely to be preferred to the heavy carving and ornate pillars and ceiling designs which were the rule fifteen or twenty years ago, and are even now indulged in occasionally.

A novel feature, for a ship of this class, is the verandah café and dancing saloon at the after end of the promenade deck.

Ample Outside Deck Spaces Provided

In the past, many steamers of the same general type as those under consideration, while provided with most extensive sleeping quarters, were notably lacking in outside deck or promenade space. It is a pleasure to note the very satisfactory way in which this want has been met by the designer of the new ships. Not only is unusually ample and unobstructed space provided on the upper or shade deck, but wide gangway spaces extend all fore-and-aft on the promenade, or boat, deck and there is also a very considerable amount of outside deck space at each end of the saloon and hurricane decks, as well. There are few, if any, similar vessels having an equal amount of outside deck space available for passengers' use.

The passenger and crew quarters are heated throughout by

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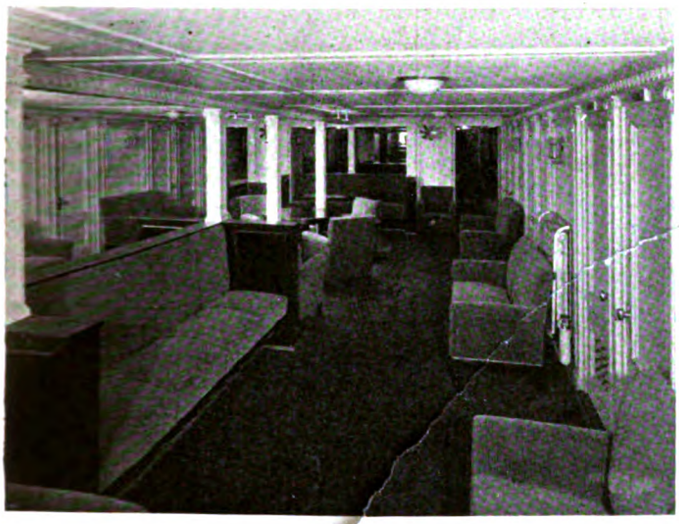
Veranda Cafe and Dancing Saloon

Smoking Room



Social Hall

Dining Room

steam and provided with electric lighting. Hot and cold running water is provided for all *de luxe* and special staterooms, barber shop, certain of the officers' rooms and for officers' and crew's wash rooms. Cold running water is supplied to the wash basins in the public toilet rooms. All the plumbing fittings were furnished by the A. B. Sands & Sons Company.

Mechanical ventilation, by means of Sturtevant motor-driven fans, is arranged for certain spaces, below decks, such as waiters' and crew's sleeping quarters and mess rooms, berth travel spaces, galley and pantry. Ample natural ventilation, by means of cowl ventilators and exhausters, is provided for public toilets, passageways, quarters forward on the hurricane deck and inside staterooms.

There are 16 ordinary and 12 collapsible lifeboats, all *stowed on* the promenade deck, under Steward mechanical davits. A somewhat unusual item of equipment is a stern anchor, fitted complete with hawse-pipe and vertical windlass and capstan.

PROPULSION IS BY GEARED TURBINES

The propelling machinery consists of two sets of Parsons cross compound steam turbines, driving twin screws through single reduction gears. The total shaft horsepower is approximately 7,6[illegible]0 with 2,240 and 140 revolutions per minute of the turbines and propellers respectively. The turbines were built by the Bath Iron Works and the reduction gears by the De Laval Steam Turbine Company. Kingsbury thrust blocks are fitted to each propeller shaft. There is a main condenser for each pair of turbines, containing approximately 4,800 square feet of cooling surface. An augmenter is fitted to each condenser.

The propellers are solid, of bronze, 3-bladed 13 feet 7½ inches in diameter, 16 feet 4 inches pitch and 55.5 square feet developed area.

Steam is supplied by six single end Scotch boilers, built by the Bethlehem Shipbuilding Corporation. Each boiler has four 42-inch corrugated furnaces with independent combustion chambers, and is 16 feet 4 inches inside diameter and 11 feet 8 inches long over heads. The working pressure is 200 pounds per square inch and the total effective heating surface about 21,000 square feet.

Oil fuel is used, the burners, heaters and other oil burning apparatus being of the Dahl type as manufactured by the Bethlehem Shipbuilding Corporation. The Howden system of forced draft is installed.

The principal engine room auxiliaries are as follows:

Two main circulating pumps, centrifugal, 14-inch (single cylinder engines) Bethlehem Shipbuilding Corporation.

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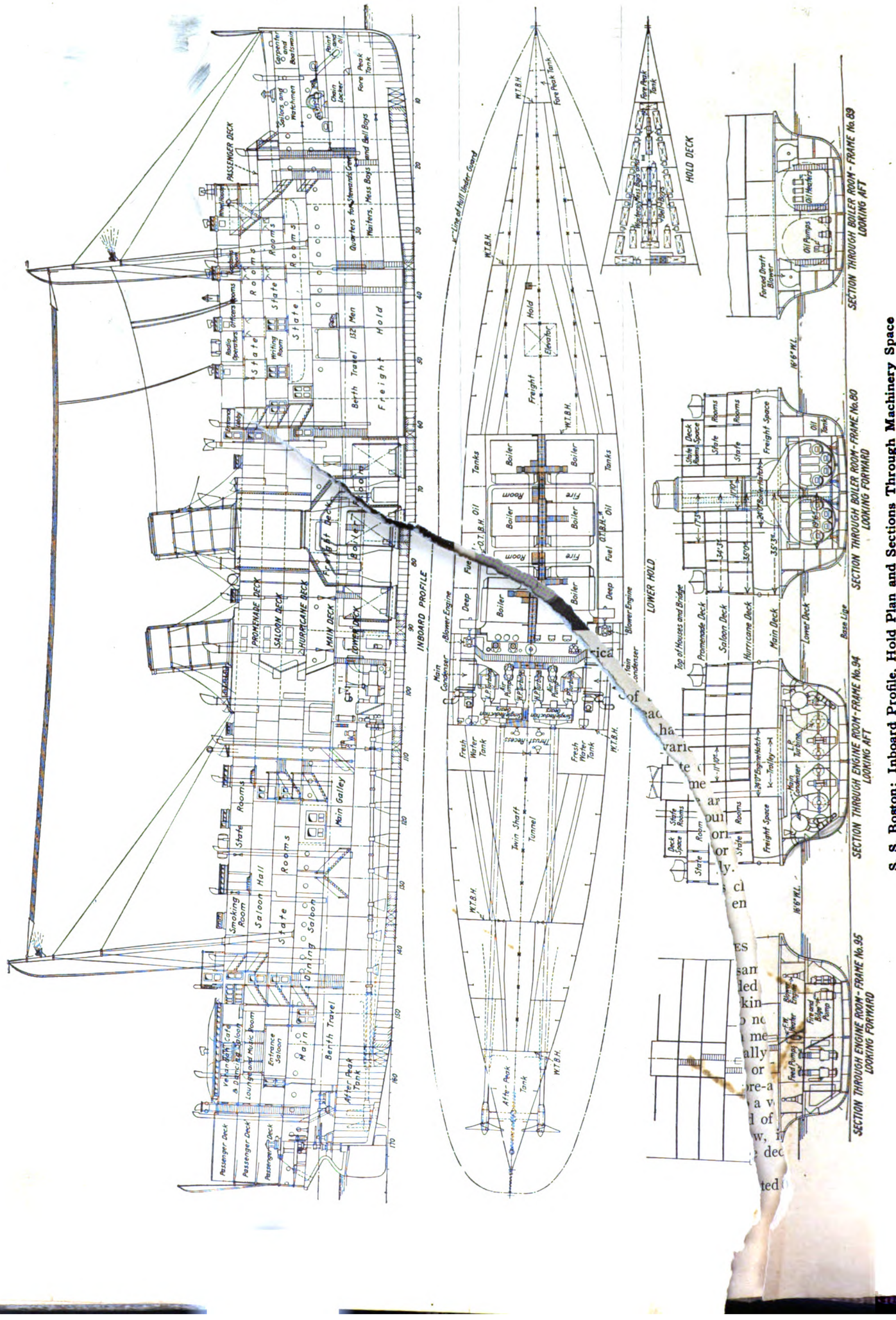

S. S. Boston: Inboard Profile, Hold Plan and Sections Through Machinery Space

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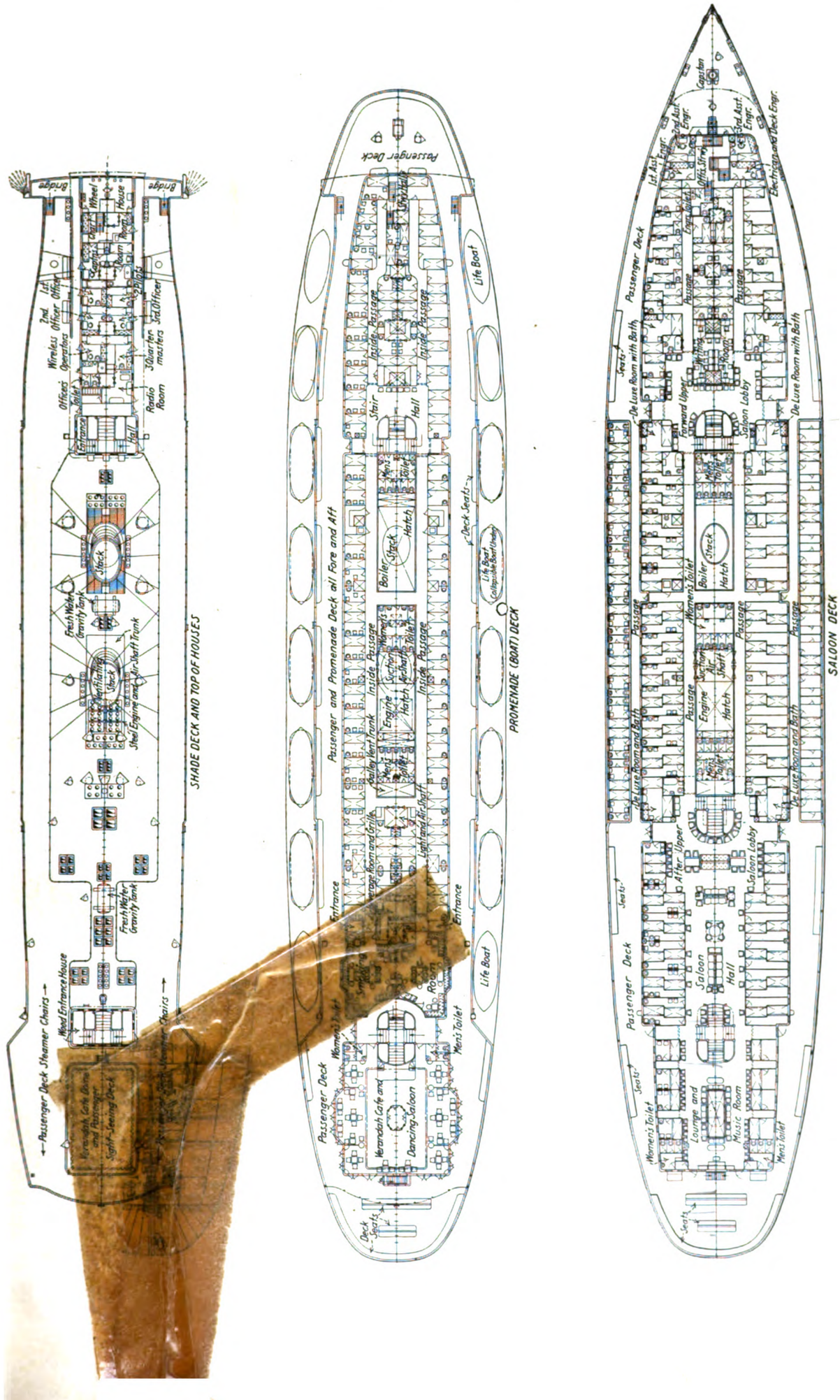

S. S. Boston: Plans of Shade, Promenade and Saloon Decks

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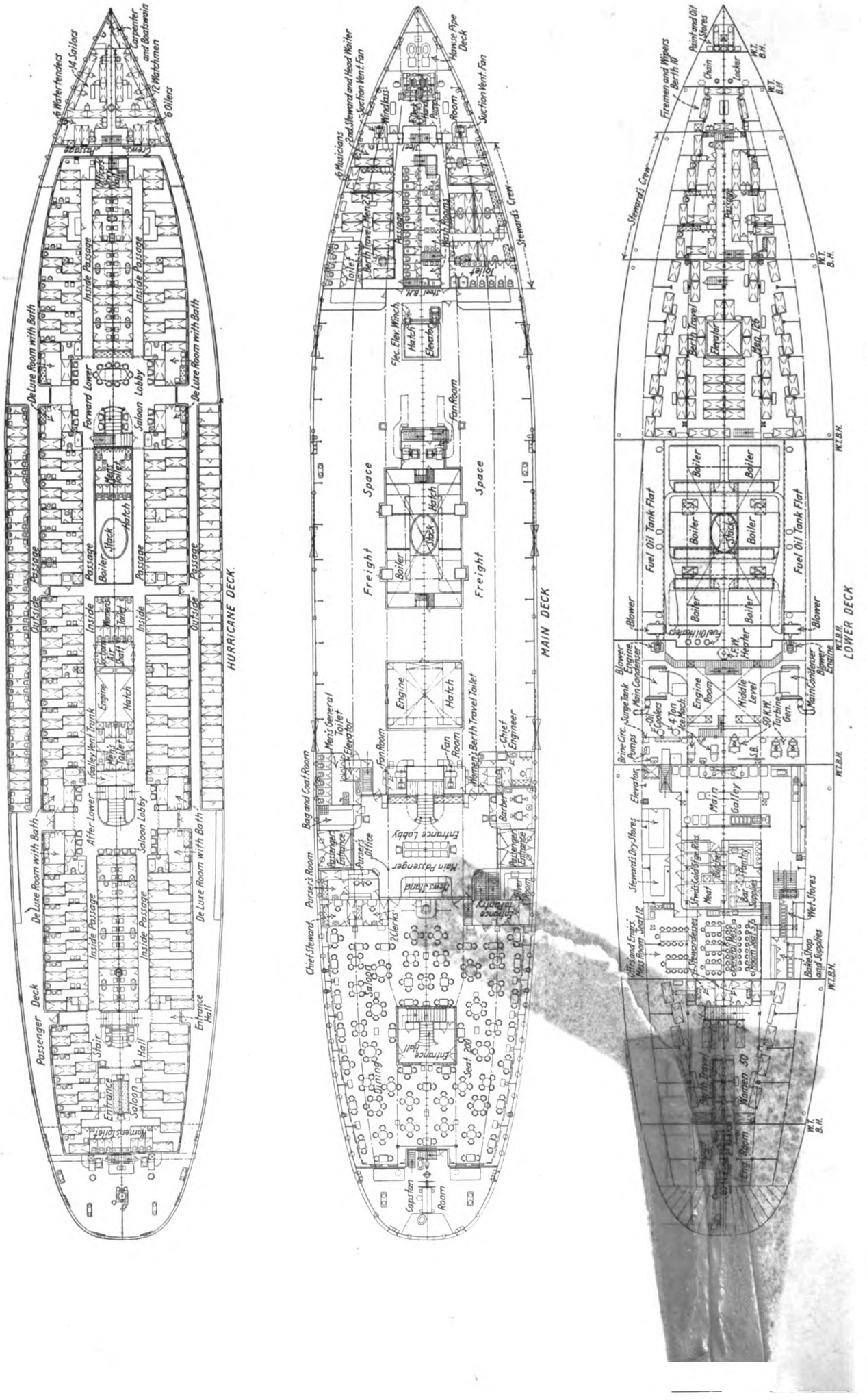

S. S. Boston: Plans of Hurricane, Main and Lower Decks

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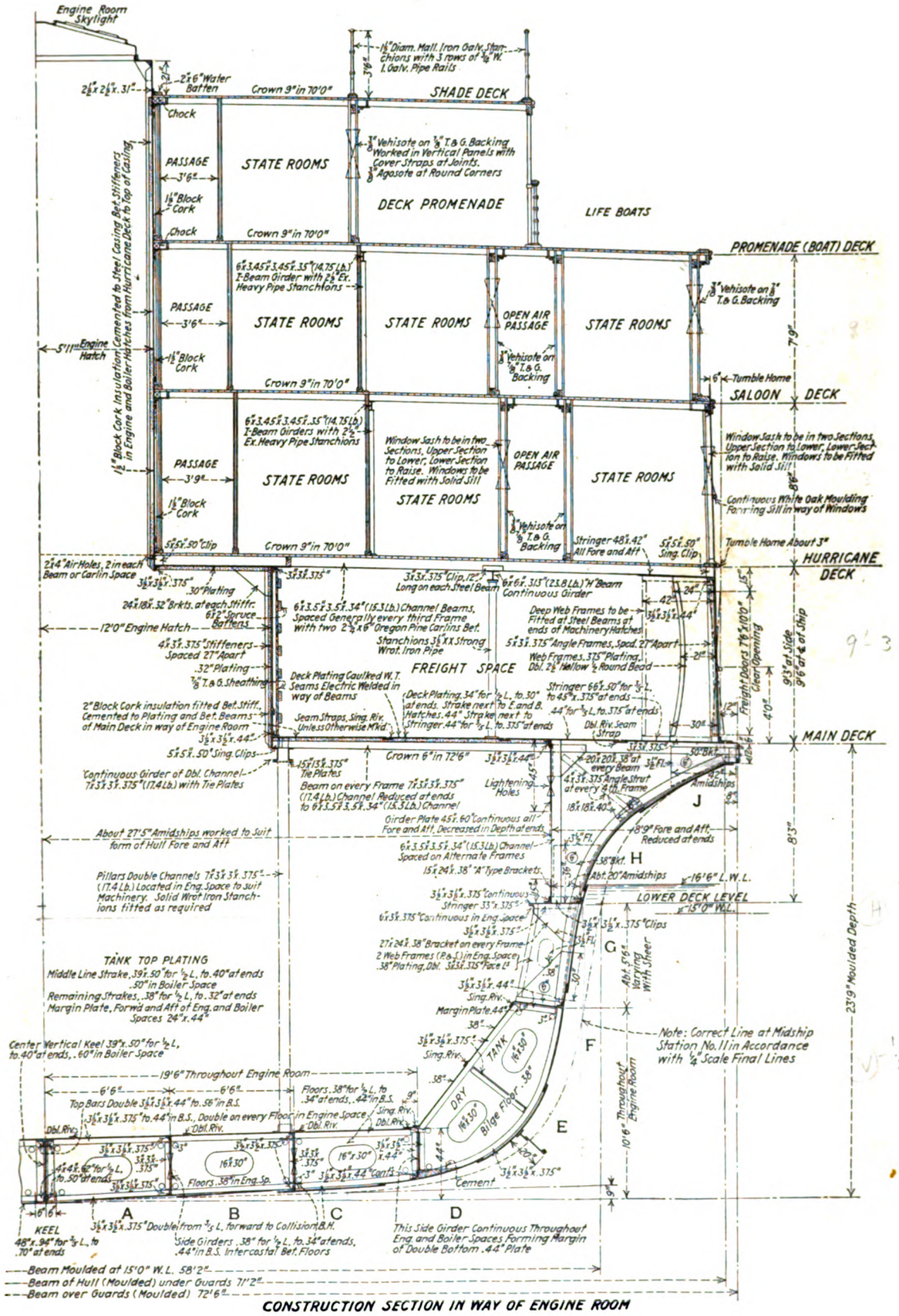

S. S. Boston: Section in Way of Engine Room

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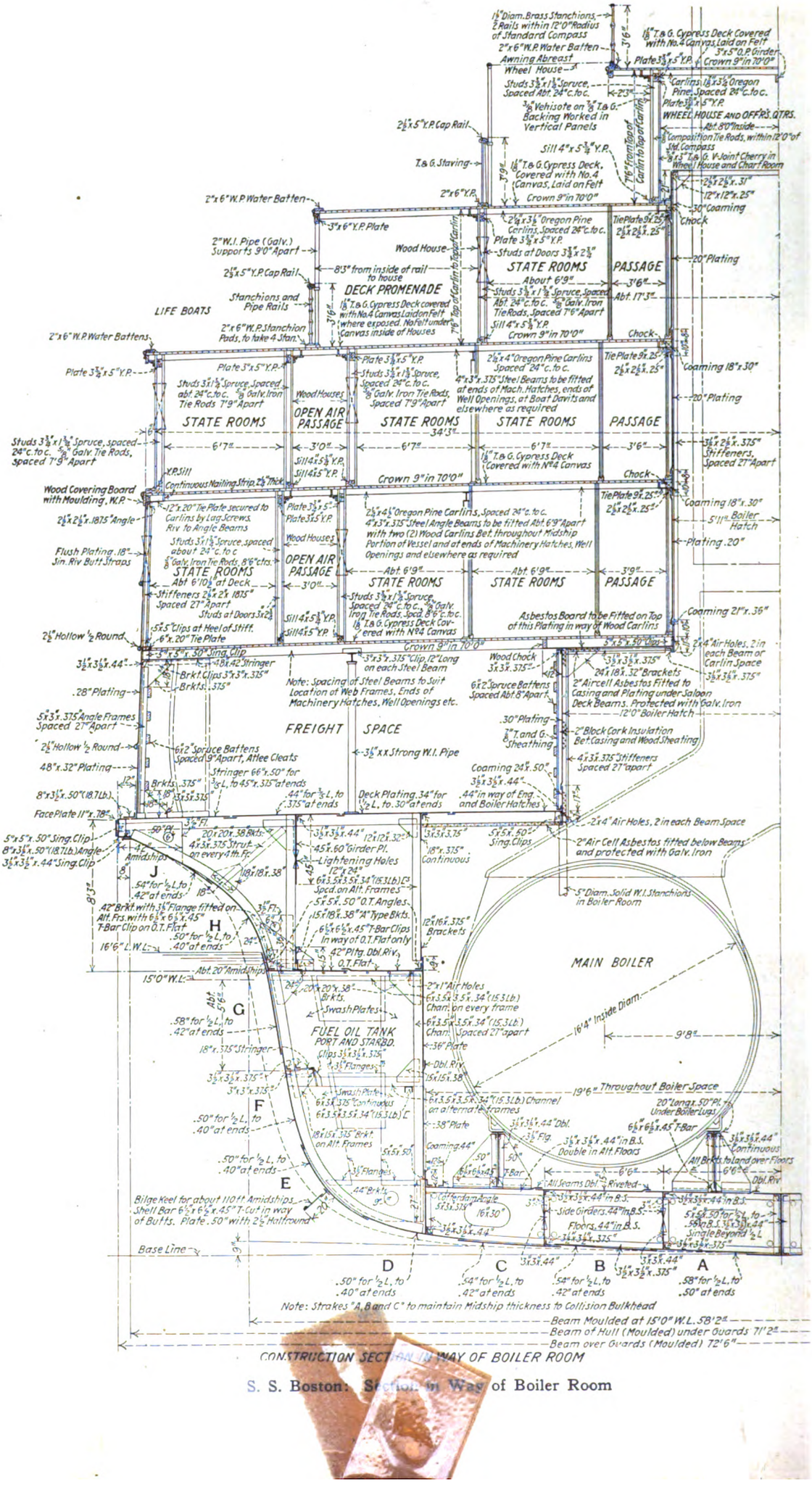

CONSTRUCTION SECTION IN WAY OF BOILER ROOM

S. S. Boston: Section in Way of Boiler Room

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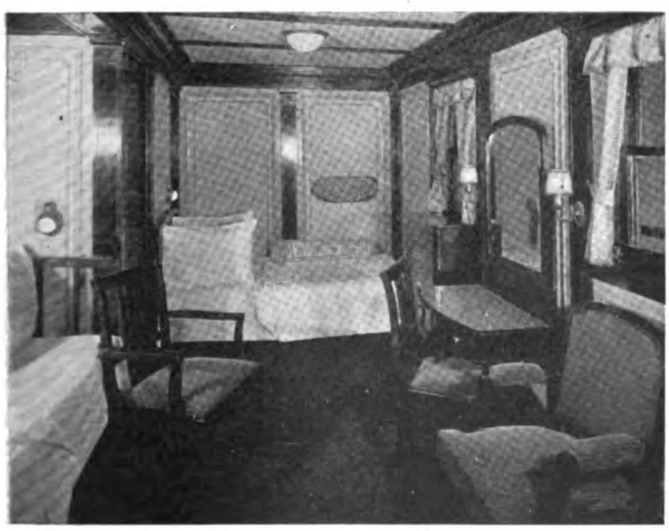
Combined Gypsy and Windlass on Hurricane Deck Aft

Two main air pumps, twin beam, 12 inches, by 28 inches by 18 inches, Blake.
Two main feed pumps, vertical simplex, 18½ inches by 13½ inches by 24 inches, Blake-Worthington.
One ballast pump, vertical duplex, 10 inches by 12 inches by 12 inches, Blake-Worthington.
One fire and bilge pump, vertical duplex, 12 inches by 8½ inches by 12 inches, Blake-Worthington.
One sanitary and oil cooler pump, vertical duplex, 10 inches by 12 inches by 12 inches, Blake-Worthington.
One fresh water pump, vertical duplex, 6 inches by 4 inches by 6 inches, Blake-Worthington.
One ice machine circulating pump, vertical duplex, 6 inches by 4 inches by 6 inches, Blake-Worthington.
One scuttle butt circulating pump, vertical duplex, 4½ inches by 2¾ inches by 4 inches, Blake-Worthington.
Two brine circulating pumps, vertical duplex, 7½ inches by 5 inches by 6 inches, Blake-Worthington.
One donkey boiler feed pump, vertical simplex, 4½ inches by 2¾ inches by 6 inches, Blake-Worthington.
Two fuel oil service pumps, vertical duplex, 7½ inches by 5 inches by 6 inches, Blake-Worthington.
One fuel oil transfer pump, vertical duplex, 7½ inches by 9 inches by 10 inches, Blake-Worthington.
Three lubricating oil pumps, vertical simplex, 8 inches by 10 inches by 12 inches, Blake-Worthington.
One oil cooler circulating pump, vertical duplex, 10 inches by 12 by 12 inches, Blake-Worthington.
Two Metropolitan injectors for main boilers, No. 14½.
One Metropolitan injector for donkey boiler, 1 inch.
One feedwater heater, Reilly multicoil.
Two forced draft fans, No. 10, design No. 3, Sturtevant. (Fans in boiler room, fan engines in engine room).



De Luxe Stateroom

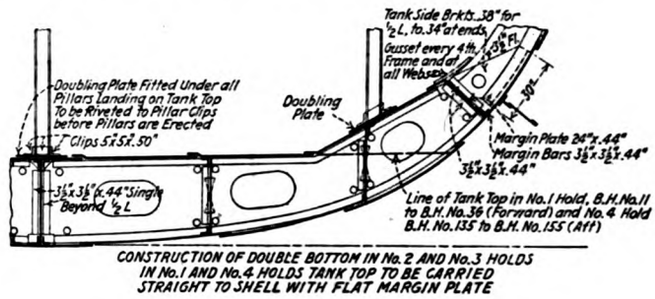
One donkey boiler, vertical, 5 feet diameter, 150 pounds working pressure.
Two refrigerating machines, 4 tons each, York Manufacturing Company. (Cold storage space, about 2,000 cubic feet).

The following deck machinery is installed:

Steam steering engine, 12 inches by 12 inches, Bethlehem Shipbuilding Corporation. (Shaft control).
Windlass, 9 inches by 12 inches, Hyde Windlass Company.
Aft windlass and gypsy, 10 inches by 10 inches, Hyde Windlass Company.
Forward gypsy, 10 inches by 10 inches, Hyde Windlass Company.
Freight elevator, 4,000 pounds capacity, 15 horsepower motor, New Era Elevator & Machine Company.
Stowage elevator, 1,000 pounds capacity, 7 horsepower motor, New Era Elevator & Machine Company.

The electric plant consists of three 60 kilowatt, 110 volt turbine-driven generating sets, the turbines of De Laval and generators of Crocker-Wheeler make. There are, in all, about 2,100 lights, as well as fans in the public rooms, officers' rooms, barber shop, berth travel and other similar spaces. An 18-inch Rushmore searchlight is installed on the wheel house.

The new steamers leave little to be desired, from the passenger's point of view, and form a welcome addition to the summer transportation facilities between Boston and New York, for which there appears to be a steadily increasing demand.


Tank Side Brkts. 38" for ½ L. to 34" at ends
Gusset every 4th Frame and at all Webs
Doubling Plate Fitted Under all Pillars Landing on Tank Top To be Riveted to Pillar Clips before Pillars are Erected
Clips 5"x5"x.50"
Doubling Plate
Margin Plate 24"x.44"
Margin Bars 3½"x3½"x.44"
3½"x3½"x.44"
3½"x3½"x.44" Single Beyond ½ L
Line of Tank Top in No. 1 Hold, B.H. No. 11 to B.H. No. 36 (Forward) and No. 4 Hold B.H. No. 135 to B.H. No. 155 (Aft)
CONSTRUCTION OF DOUBLE BOTTOM IN No. 2 AND No. 3 HOLDS
IN No. 1 AND No. 4 HOLDS TANK TOP TO BE CARRIED
STRAIGHT TO SHELL WITH FLAT MARGIN PLATE

Double Bottom in Nos. 2 and 3 Holds

CRAMP CRUISERS TO RE FLAGSHIPS.—Three of the five light cruisers built at the Cramp shipyard in Philadelphia have been designated by the Secretary of the Navy to serve as flagships. Eight light cruisers similar in type and construction are to be placed in two divisions. The *Richmond*, the first of these vessels to be delivered by the Cramp Company, will head one division as the flagship, and the *Marblehead*, now being completed at the Cramp yard, has been designated as the flagship of the other division. The *Concord*, second of the Cramp-built cruisers to be commissioned, will head the destroyer squadrons of the United States Navy as flagship. The *Trenton* will be in the same division with the *Richmond*, and the *Memphis* has been assigned to the division headed by the *Marblehead*.

BRITISH SHIPBUILDING OUTLOOK.—The British shipbuilding situation is little better than it was a year ago in spite of the increase of orders which appeared during the autumn and winter, according to advices to the Department of Commerce from Commercial Attache Tower, London. Tonnage actively under construction is some 5 percent larger, but the extent to which tonnage launched during the March quarter exceeded tonnage commenced indicates that comparatively soon the number of idle ships will increase again, unless ship operators show more interest in buying new vessels. Such reports as are available indicate that launchings continue to exceed keels laid down. The Clyde has benefited more than any other of the principal shipbuilding centers, although the gain is slight.

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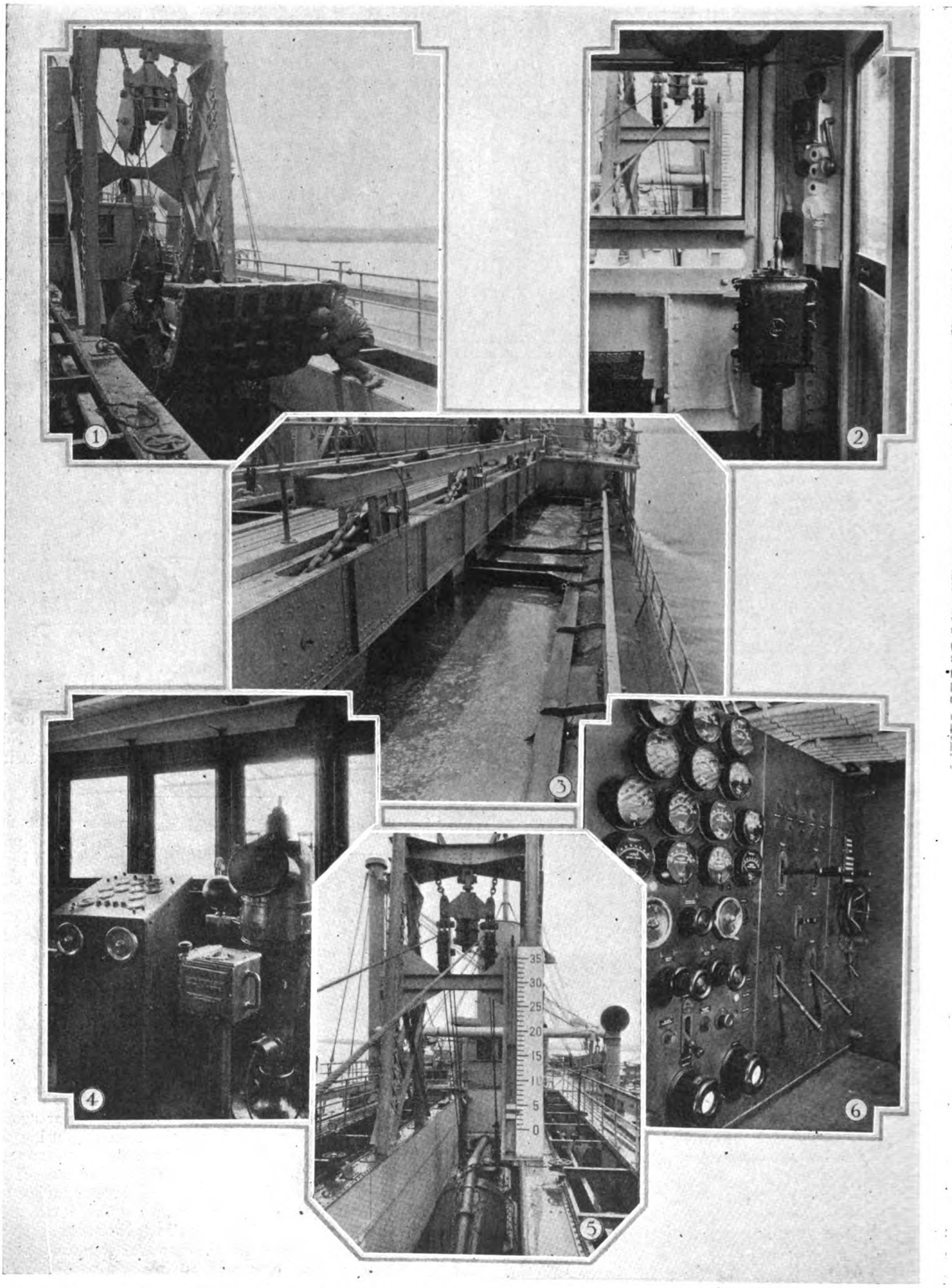

Fig. 1.—Diesel-Electric Army Dredge A. Mackenzie: (1) Drag; (2) Ladder Hoist Control; (3) Full Hopper; (4) Control Station in the Pilot House; (5) Indicator of Depth of Drag Below Bottom of Ship; (6) Control Station, Combination Switch (Wheel) at Right, Engine Room Control (Two Wheels) at Left

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Diesel-Electric Dredge A. Mackenzie Completes Trials

First of the New Diesel-Electric Sea-Going Army Dredges Given an Exhibition Run in New York Harbor

THE *A. Mackenzie,* the first of four Diesel-electric dredges being built by the Sun Shipbuilding and Dry Dock Company, Chester, Pa., for the Engineer Department, U. S. Army, has successfully completed her preliminary trials and on June 6 was given an exhibition run in New York harbor which was attended by a large and much interested party of engineers and dredging experts and contractors.

In our April issue there appeared an illustrated description of these very novel and unusual vessels, and we are now able, thanks to the courtesy of the Westinghouse Electric & Manufacturing Company, to publish further illustrations and descriptive matter.

The outstanding and most important characteristic of the dredges is the universal use of electricity, for heating and cooking, as well as for propelling, dredging and all other functions requiring power. We believe that they are the first large and important vessels in which electricity and internal combustion engines have been used, to the entire exclusion of steam. The total capacity of the Diesel-electric plant exceeds that of any other vessel which has so far been constructed.

Fig. 2.—First Diesel-Electric Dredge on Exhibition Run

The main generating plant comprises three units, each consisting of a McIntosh & Seymour single acting, 4 cycle Diesel engine of 1,000 brake horsepower, directly connected to a 700 kilowatt 500 volt direct current Westinghouse generator. Two of these units are located in the forward and one in the after engine room. The main engines and generators run at 150 revolutions per minute, when developing full power. Each engine has six cylinders, 22 inches in diameter and 32 inches stroke.

Propelling Machinery

The ship is propelled by twin screws, each driven by an 800 horsepower, 480 volt motor, designed to develop full power at 110 revolutions per minute, when running free, and 90 revolutions when dredging. The propellers are four bladed, of the built-up type with bronze blades and cast steel hubs; and are 11 feet in diameter and 12 feet 3 inches pitch.

Fig. 3 (6) shows the port propelling motor (at the right) and the after generator, with its ventilating trunk. Fig. 3 (1) shows the ventilating fan and motor connected to this generator. Fig. 3 (2) shows one of the main generators in the forward engine room.

Dredging is accomplished by a 26-inch centrifugal pump, shown in Fig. 3 (4), located on the port side of the forward engine room and driven by a direct connected motor, shown in Fig. 3 (5), of 750 horsepower, 480 volts, and running at 150 revolutions per minute.* The pump suction is led through the trunnion of the dredging ladder and down the latter to the drag, as shown in Fig. 1 (1 and 5), which may be lowered to a depth of 35 feet below the keel of the ship. The discharge from the pump is led to longitudinal troughs on deck, as shown in Fig. 1 (3), and by them distributed to the four hoppers. The general arrangement of the discharge troughs and hoppers is clearly shown on the plans published in our April issue.

Control

One of the most interesting features of the installation is the control of the propelling and dredging machinery and the arrangements of wiring, whereby either main generator may be used for propelling or dredging. This is centered around a hand operated control switch group, by means of which the operator may select any one of eight combinations or connections of the main machinery. This "set up" group consists of a number of contactor switches, operated by cams on a shaft geared to the operating hand wheel, shown in Fig. 1 (6), on the engine room switchboard, shown in Fig. 3 (3). An indicator near the hand wheel, shown in Fig. 1 (6), shows the operator the various steps and connections. The following main circuit connections can be effected:

Connections

All circuits open

Position

1 Generator No. 1 to motor No. 1;
2 Generator No. 2 to motor No. 2;
Generator No. 3 to dredging pump motor.
3 Generator No. 1 to motors No. 1 and No. 2;
Generator No. 3 to dredging pump motor.
4 Generator No. 2 to motors No. 1 and No. 2;
Generator No. 3 to dredging pump motor.
5 Generator No. 2 to motors No. 1 and No. 2;
Generator No. 1 to dredging pump motor.
6 Generator No. 3 to motor No. 1;
Generator No. 2 to motor No. 2.
7 Generator No. 1 to motor No. 1;
Generator No. 3 to motor No. 2;
Generator No. 3 to motors No. 1 and No. 2

Motors No. 1 and No. 2 are the port and starboard propelling motors respectively.

The "set-up" switch group makes only the proper armature

*This pump has a cast steel body with detachable front and back heads. The impeller is 6 feet 9 inches diameter and 13 inches between shrouds at the periphery. The impeller shaft is 10 inches in diameter.

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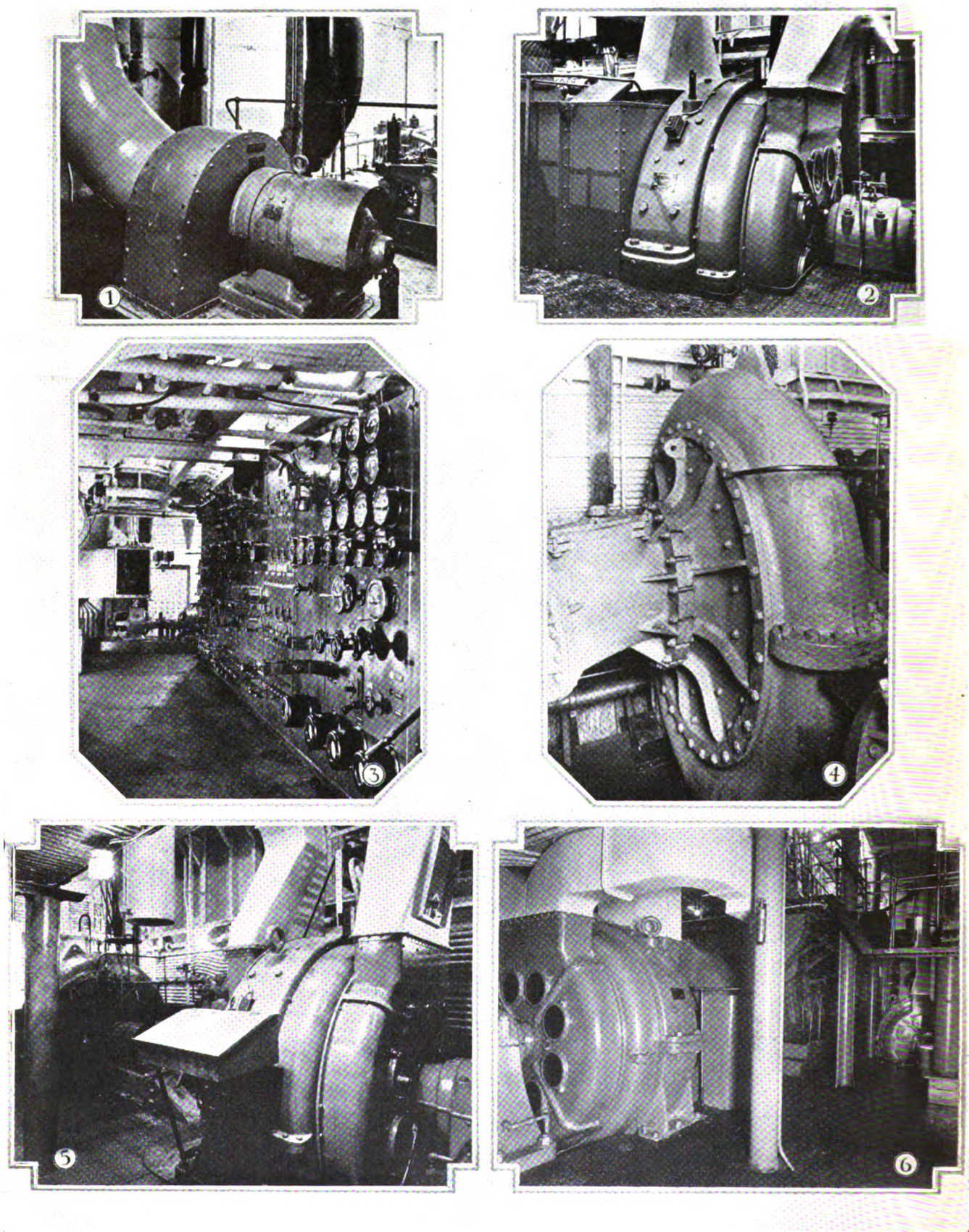

Fig. 3.—Diesel-Electric Army Dredge A. Mackenzie: (1) Ventilating Fan for Main Generators in After Engine Room, (2) 700-Kilowatt Main Generator in Forward Engine Room, (3) Switchboard, (4) Dredging Pump, (5) 800 Horsepower Pump Motor, (6) After Engine Room Showing (at Left) 700-Kilowatt Main Generator and (at right) 800 Horsepower Port Propelling Motor

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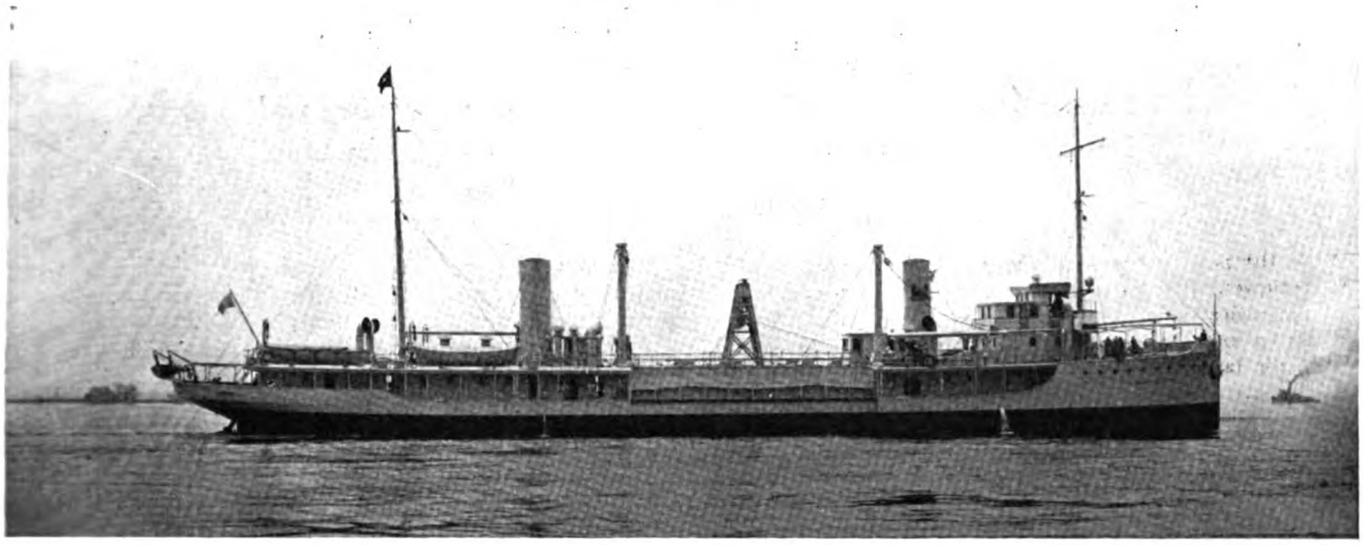

Fig. 4.—Diesel-Electric Army Dredge A. Mackenzie

and field connections of the main machinery, as listed above, and the operating mechanism is so interlocked with the main control circuit that the hand wheel cannot be moved while there is power on the main circuits. After the set up connections are thus made, complete control of the starting, stopping, reversing and speed variation of the propelling motors is carried out by controlling the excitation of the generators supplying power to them, both the motors and generators being separately excited from the auxiliary generator.

There are two control stations, one in the pilot house, shown in Fig. 1 (4) at the left, and one in the after engine room, shown in Fig. 1 (6) at the left and in Fig. 3 (3) at the right.

In addition to the main plant, there are two Diesel-driven auxiliary generating sets, each consisting of a 225 brake horsepower McIntosh & Seymour engine direct connected to a 150 kilowatt, 250 volt, 275 revolutions per minute, direct current Westinghouse generator. These machines are arranged for single or parallel operation to supply power for excitation of the propelling and dredging machinery, and for the various auxiliaries. There is also a 25 kilowatt 250 volt emergency generator, driven by a gasoline engine.

AUXILIARIES

Because of the special work they will be called on to perform, each vessel carries an unusual number of electrically operated auxiliaries. These include pumps requiring from one to 150 horsepower, air compressors, refrigerating machine, steering gear, windlass, capstans, winches, hopper door operating gear, dredging ladder hoist, machine shop tools and ventilating sets.

The engine room auxiliaries and motors are as follows:

No.	Pumps	Forward or Aft Engine Room	Type	Head, in Feet	Gallons Per Minute	Horsepower of Motor	Revolutions Per Minute
2	Lubricating oil	F.E.R.	Rotary	75	64-126	5	600-1150
2	Lubricating oil	A.E.R.	Rotary	75	31-64	3	600-1150
2	Fuel oil	F.E.R.	Rotary	230	27-51	5	600-920
2	Fuel oil	A.E.R.	Rotary	230	27-51	5	600-920
1	Engine room bilge	F.E.R.	Rotary	50	64-126	5	600-1150
1	Engine room bilge	A.E.R.	Rotary	50	38-77	3	600-1150
1	Sanitary	A.E.R.	Rotary	60	38-77	3	600-1150
1	Fresh water	A.E.R.	Rotary	60	38-77	3	600-1150
2	Fuel oil heating	F.E.R.	Rotary	60	31-64	3	600-1150
2	Fuel oil heating	A.E.R.	Rotary	60	31-64	3	600-1150
1	Service	F.E.R.	Rotary	140	35-74	5	600-1150
1	Distillate transfer	F.E.R.	Rotary	50	31-64	3	600-1150
1	Distillate transfer	A.E.R.	Rotary	50	31-64	3	600-1150
1	Fire and bilge	F.E.R.	Centrifugal	230	500	50	1700
1	Jet	F.E.R.	Centrifugal	200	2000	150	1700
2	Engine circulating water	F.E.R.	Centrifugal	50	800	20	1700
2	Engine circulating water	A.E.R.	Centrifugal	50	600	15	1700

In addition, there are 5 motors driving machine tools and aggregating 13 horsepower a 7½ horsepower motor for the Johns-Manville refrigerating machine, 1 horsepower brine pump motor, 15 horsepower starting air compressor motors, 5 horsepower compressor for whistles and for each main generator a 7.3 horsepower ventilating motor.

Coming to the deck auxiliaries, there is a 30 horsepower motor for the steering gear, 25 horsepower motor for the windlass, 20 horsepower for each capstan, 15 horsepower for each cargo winch, two 3 horsepower motors for operating hopper doors, and a 50 horsepower motor for the ladder hoist.

All the living spaces are fitted with electric heaters, and heater coils are also installed in the fuel oil tanks, and for furnishing hot water to wash basins and baths and to the galley. An Edison electric range is fitted in the galley.

EXHIBITION RUN

On the exhibition run of the *A. Mackenzie,* in New York harbor and outside of Sandy Hook, the performance of all the machinery indicated a very large reserve of power to meet all possible contingencies, and was notable for the positive and prompt control of generators and motors, both when dredging and when running free. The impression created on the spectators was, in the highest degree, favorable and we understand that at least one of the large dredging companies is to proceed very shortly with the construction of a Diesel-electric vessel.

The *A. Mackenzie* will shortly enter active service at Mobile, Alabama, and of the three remaining vessels, which will be completed this summer, the *W. L. Marshall* will be stationed at New York, the *Dan C. Kingman* at Savannah, Georgia, and the *William T. Rossell* at Seattle, Washington.

The service reports of these vessels will be awaited with the keenest interest by everyone connected with dredging and harbor improvement work, as well as by naval architects and engineers in general.

THE NATIONAL FOREIGN TRADE COUNCIL, at its eleventh convention, declared that development and maintenance of a merchant marine under the American flag, privately owned and operated, are essential to both our commerce and our national defense. The chief agency for the accomplishment of this purpose is the support of American ships by American exporters and importers. The shipping policy of the United States makes it impossible for private capital to purchase steamers and compete with Government owned tonnage in foreign trades. Government owned ships should be under individual control similar to the Army and Navy rather than under divided authority.

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Ventilating Passenger and Crew Accommodations

Factors Determining the Number of Air Changes Necessary and Details of Ventilating Requirements of the United States Lines

By W. E. Spofford*

FOR the past twenty years the steamship companies have followed the progressive policy of improving the amenities of ocean travel by equipping their vessels and fitting out the accommodations to make them second only to the largest and most modern hotels ashore and coincident with this, many improvements have been made in the ventilation, interior decoration and equipment on board these vessels.

In discussing the subject of ventilation it must be granted that the designer has obviously more leeway on a ship in the building than on a reconditioning job where certain conditions are fixed, but in either case, his objectives are to supply sufficient fresh air, remove the vitiated air and to comply with the laws of the countries between which the ship plies or touches.

The most important of the numerous and varied conditions to be dealt with in the design and installation of a ventilation system are:

1. Class and number of occupants.
2. Type of system.
3. Location and character of space.
4. Location of blowers.
5. Sizes of mains and ducts.

Class and Number of Occupants

The class and number of occupants determines the amount of air to be supplied, and while the British law requires 850 cubic feet per hour per person, the general practice is to allow not less than 1,500 cubic feet per hour per person for second class, third class and crew and 1,800 cubic feet per hour per person for first class accommodations. Another method of calculating the necessary amount of air is the "change of air per hour" method. Changes of air for different spaces on several vessels based on the latter method are shown in Table 1.

TABLE 1—CHANGES OF AIR PER HOUR

Vessel	First and Second Class Dining Rooms	First and Second Class Smoking Rooms	Third Class Smoking Rooms	Sleeping Compartments First Class	Sleeping Compartments Second Class	Sleeping Compartments Third Class	Third Class Dining Room	Galleys and Pantries	Hospitals	Bathrooms	Toilets	Swimming Pool	Crew's Spaces	Storerooms	Engine Room	Dynamo Room	Ice Machine Room	Magazines
Majesite and *Leviathan*	20	20	..	10	6 to 10	6 to 10	18	40	15	20	30	30	6 to 10	..	..	..	..	..
America	Cabin 6	..	..	..	Cabin 10	18	1	10	20	..	20	..	8	3	..	..	..	..
Siboney	000	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orizaba	..	20	..	..	..	..	..	50	..	..	15	..	..	5	30	15	20	8
President Polk	..	..	12	..	..	6	12	30	..	..	12	..	..	..	..	..	..	..

TABLE 2—RATIOS OF PERSONS TO CUBIC FEET OF SPACE

Change Per Hour	Change in Minute	Ratio Number of Persons to Cubic Feet
60	Every 1 minute	1 to 25
30	Every 2 minutes	1 to 50
20	Every 3 minutes	1 to 75
15	Every 4 minutes	1 to 100
12	Every 5 minutes	1 to 125
10	Every 6 minutes	1 to 150
8	Every 7½ minutes	1 to 187.5
6	Every 10 minutes	1 to 250
5	Every 12 minutes	1 to 300
4	Every 15 minutes	1 to 375

In making the preliminary calculations for the necessary amount of air it should be noted that if the ratio of persons to cubic feet of space exceeds that given in Table 2, for the corresponding change of air, the cubic feet per minute per person method should be used. If the ratio of persons to cubic feet of space does not exceed the ratio given, the change of air per hour method should be used. If the ratio of persons to cubic feet of space equals the factor given in the table either method may be used.

The superficial feet deck area is fixed by the United States Steamboat Inspection Service rules and regulations as follows:

Class of Passenger Accommodations	Superficial Feet
Cabin	36
Third Class Above Lowest Deck	15
Third Class On Lowest Deck	18
Crew	16

The lowest allowable head room or deck height is 6 feet; therefore, the lowest allowable ratio, persons to cubic feet is 1 to 90, but this ratio seldom goes below 1 to 144 in third class and has run as high as 1 to 250 in several transatlantic liners.

The ratios in Table 2 are indicated graphically by the curves on Fig. 3, on which the scales are laid off as follows:

1. Represents capacity (cubic feet) of inclosure.
2. Air delivery in cubic feet per minute.
3. Ratios of persons to cubic feet of space.
4. Number of persons.

The curves numbered 1 to 10 represent the complete changes of air in one to ten minutes. With the assumption that the minimum amount of air delivered shall be 25 cubic feet per minute per person, the cross curve, marked (A), has been drawn to show graphically the neutral points where either method of calculation may be used.

It will be noted that for any ratio, persons to cubic feet of space, which if plotted comes above or to the left of the curve (A) the "change of air per hour" method should be used and for any ratio plotted below or to the right of the curve (A) the 25 cubic foot per minute per person method should be used. This will insure a minimum of 25 cubic feet per minute per person for the conditions given.

Types of Systems

The different combinations or types of systems in general use are as follows:

1. Mechanical Supply—Mechanical Exhaust.

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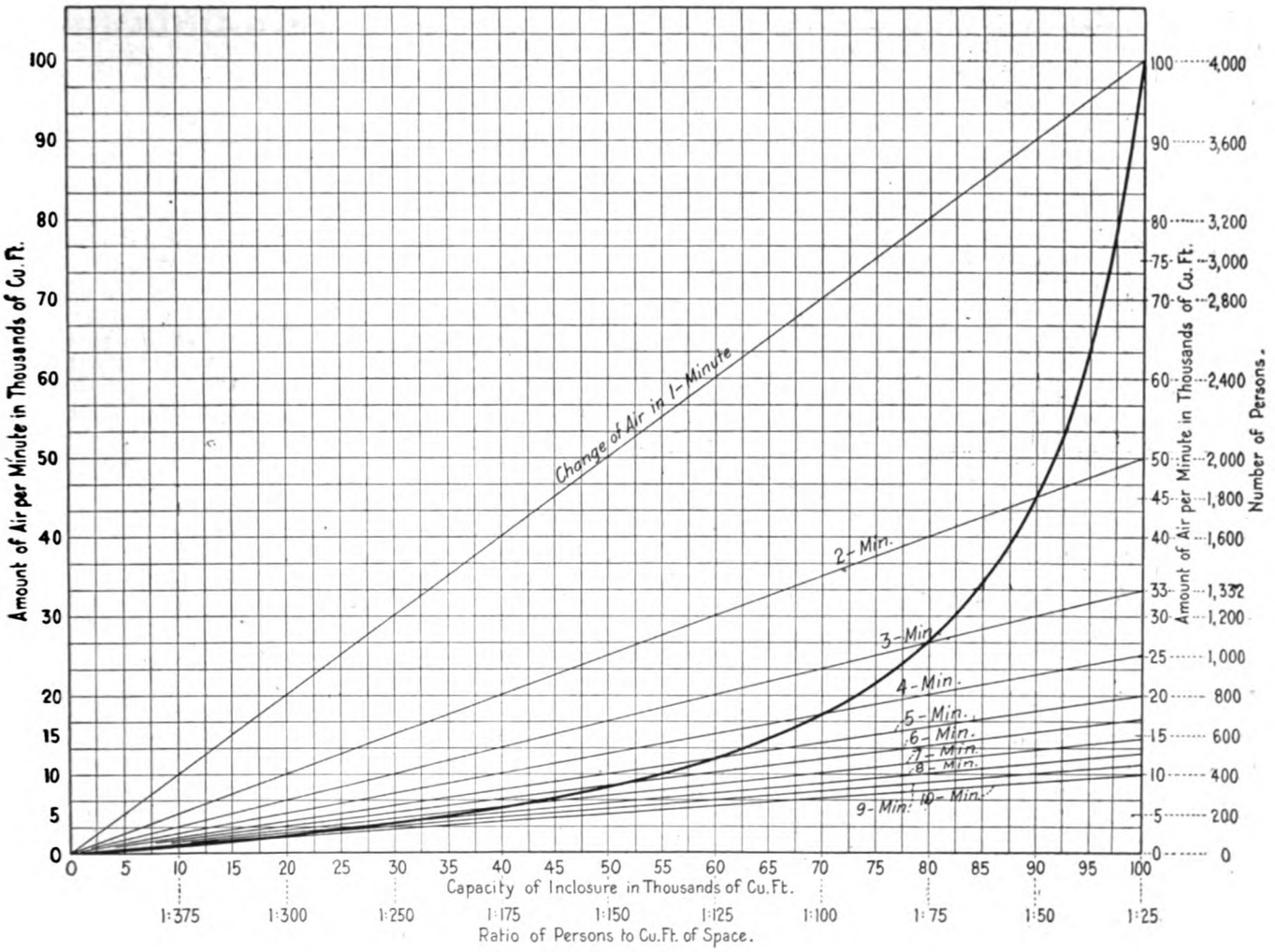

Fig. 1

2. Mechanical Supply—Combination Mechanical and Natural Exhaust.
3. Mechanical Supply—Natural Exhaust.
4. Natural Supply—Mechanical Exhaust.

In a paper read recently before the Institute of Heating and Ventilation Engineers in England, J. L. Musgrave stated that, "It is now the recognized procedure to provide what is practically a balanced system of ventilation, in which well placed extract openings, situated generally near the sources of vitiation and connected to powerful fans, set up a continuous movement of air throughout the spaces being dealt with and prevent the accumulation of stagnant air in pockets."

While it is well recognized that the most efficient means of ventilation is the balanced mechanical supply and exhaust system, there are conditions where other types of systems may be used to advantage. Air supplied to an inclosure is practically useless unless there is ample means of escape for the vitiated air and conversely if vitiated air is withdrawn there must be ample means of supply.

Fig. 4 illustrates a mechanical supply and mechanical exhaust system recently installed in the cabin dining saloon of the steamship *America*. The air is carried to the deck at port and starboard sides and is discharged through the outlets into sheet metal hoods. The air passes around and through radiators in the hoods, is heated and is then discharged into the dining saloon through brass registers located under each portlight and at a height of eighteen inches above the deck. Electric wall bracket fans are installed on the panels between and at the same height as the port lights and are directed at a 45-degree angle aft. These fans prevent the accumulation of the air at the deckhead at the sides and direct the vitiated air toward the exhaust inlets which are located at the top of the after bulkhead on the port and starboard sides. The air is exhausted in this manner in order that the odors from the galley spaces, which are aft of the dining saloon, would not become obnoxious to the diners. While the ventilation of the galley spaces is dealt with separately, this practice of having the flow of air in the dining room toward the galley insures adequate ventilation at all times in the dining room.

Fig. 5 illustrates a mechanical supply and combination mechanical and natural exhaust system which was recently installed on the steamship *George Washington*. The air is supplied by blowers located on the forward fidley top through ducts leading to outlets in the individual staterooms. The vitiated air is exhausted through the toilets by a blower located in this compartment adjacent to the toilets and is discharged in the open air above the boat deck. The ventilation is further aided by a 28-foot by 2-foot air trunk on each side of the fidley casing which is open to the air on the boat deck.

Mechanical Supply and Natural Exhaust System

Fig. 6 illustrates a mechanical supply and natural exhaust system installed in the third class accommodations of the steamship *President Polk*. The air is supplied by two blowers, located under the ladders and is delivered to the individual staterooms through expanded terminals, each fitted

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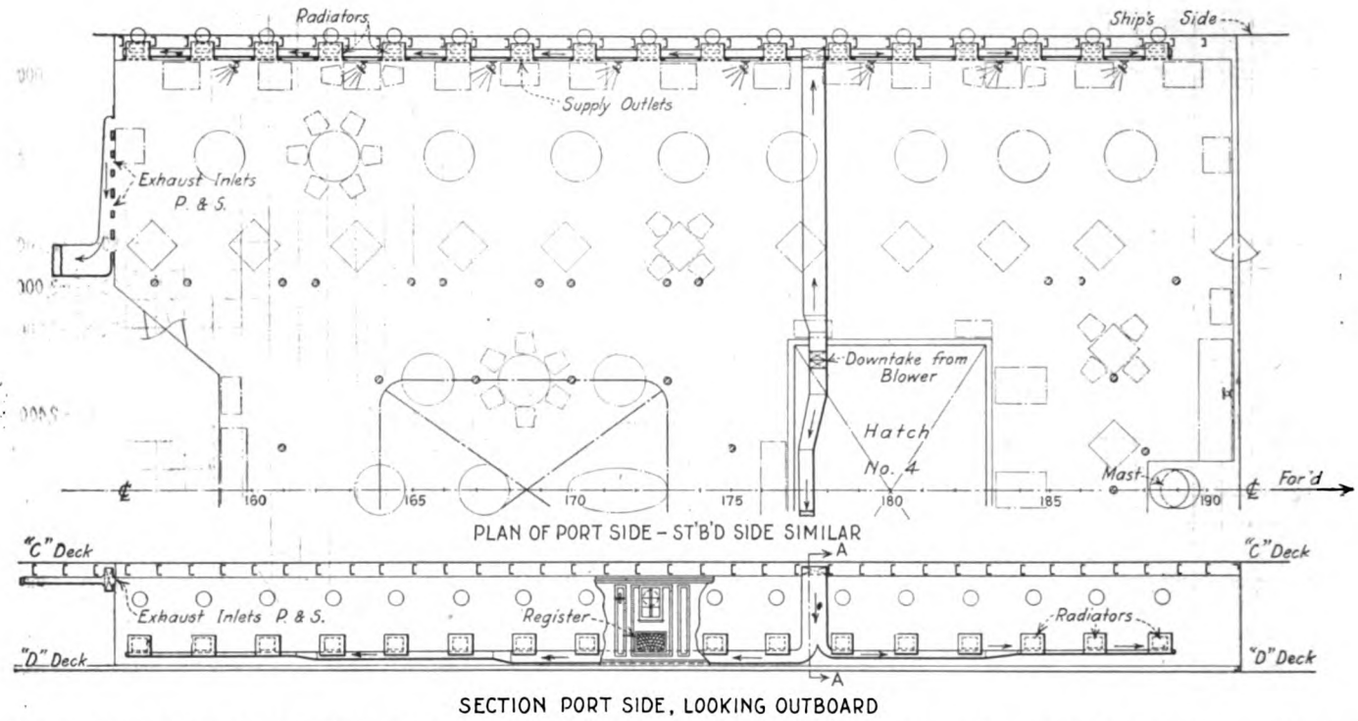

Fig. 2.—Ventilation of Cabin Dining Saloon of S. S. America by Means of Mechanical Supply and Mechanical Exhaust System

with a butterfly type damper. The terminals are brought down over the washbasins to within 6 feet of the deck, directing the air downward and bringing the dampers within reach for control by the occupants of the rooms. The natural exhaust consists of 12-inch screw down mushrooms, two of which were installed atop each booby hatch, thereby complying with the British Board of Trade Regulations. This type of system is generally installed, as in this case, forward or aft of galleys, pantries, etc., the object being to build up a pressure adjacent to these spaces to prevent the spread of the odors usually connected therewith.

The natural supply and mechanical exhaust system is generally used in such spaces as bathrooms, toilets and soiled

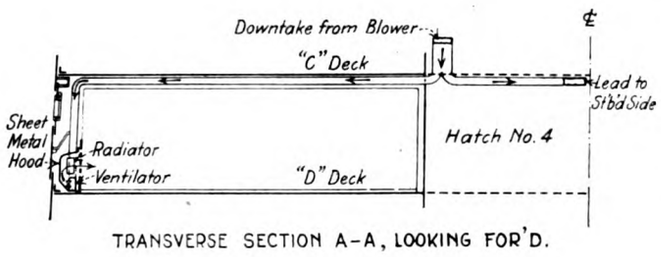

Fig. 2a

linen rooms. Where conditions are favorable this system is also frequently used in galleys, pantries and smoking rooms. In toilets, baths, etc., the air is supplied through louvers in the lower panels of the doors. With respect to galleys, pantries, etc., a good practice is to build up a pressure in the compartments fore and aft of such spaces by mechanical supply to prevent the odors from permeating the passenger accommodations.

Location and Character of Space to be Ventilated

The location of the space to be ventilated below the weather deck should be considered because of the necessity of supplying and exhausting from and to the open air. This becomes a matter of importance on large passenger vessels as is illustrated by the compartment on the steamship *George Washington* shown in Fig. 5, which is over 50 feet below the boat deck. This situation is somewhat intensified by the limited areas allowed for air mains by the type and construction of the vessel and becomes most acute when the space to be ventilated lies below the bulkhead deck and where there are no large trunks at hand.

On the steamship *Leviathan* the distances are considerably greater than that mentioned above, but this vessel is more easily ventilated because of the numerous large trunks to the blower rooms through which forced air mains are led.

The location of blowers depends entirely upon the location of the space to be ventilated, but a good general rule to follow, if practicable, is to locate all supply blowers without heaters on an open deck directly over the space to be ventilated and exhaust blowers within the space to be ventilated. The length of mains should be a minimum.

Size of Mains and Ducts

The increase in the proportions of passenger vessels has somewhat changed the design factors of ventilation systems. This has been especially noticeable in the length of mains, which have run close to 100 feet in some of the larger vessels. Wherever practicable, the length should be kept to within 60 feet to avoid excessive loss of head. The velocity in mains should not exceed 4,000 feet per minute and at outlets 500 to 700 feet per minute depending upon the use and size of the space. In hospitals it should be kept as low as possible to avoid excessive drafts.

Good practice for the thickness of metal ducts is as follows:

Area	B. & S.—Gage
50 square inches	18
50-150 square inches	16
Over 150 square inches	12

The determination of sizes of ducts has been purposely omitted, therefore the reader interested in ship ventilation is referred to the excellent article by Commander G. A. Bisset, C.C., U.S.N., published in the September, 1920, issue of Marine Engineering and Shipping Age, entitled, "Ventilation Systems." This article deals with a graphic

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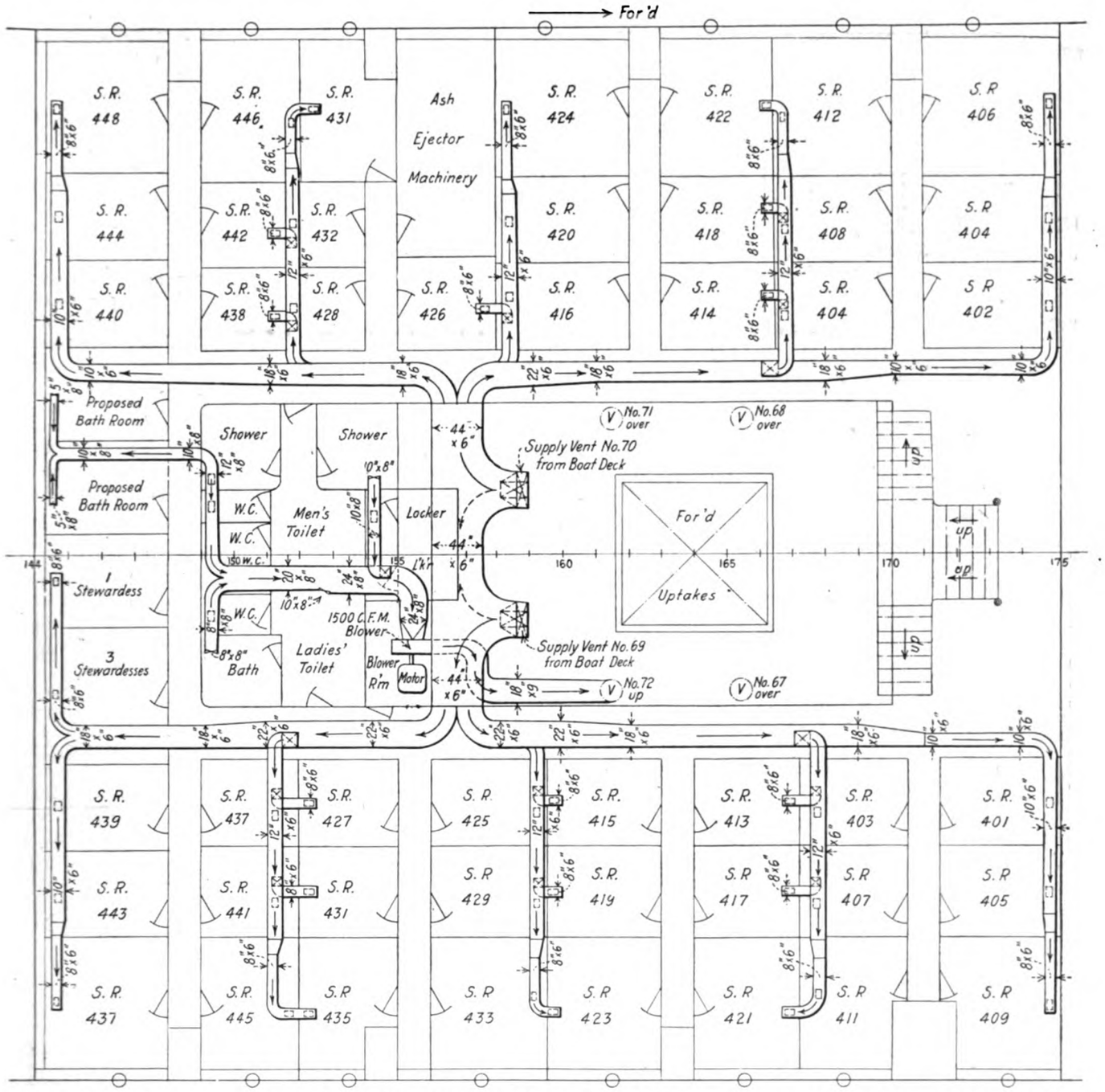

Fig. 3.—Mechanical Supply and Combination Mechanical and Natural Exhaust System Installed on the S. S. George Washington

method of determining the sizes of mains and ducts for mechanical ventilation systems.

The following extracts from the general clauses for ventilation specifications indicate the standard practice adopted by the construction department of the United States Lines. "The air mains are to be carried to the various compartments as specified, with branches to each individual room. In compartments without individual rooms or where the rooms are large, the air is to be distributed by sufficient branches and outlets so placed as to give equal distribution of air throughout the space. Under no condition shall transverse watertight bulkheads be cut for ducts below the designated bulkhead deck."

FANS AND MOTORS

"All fans are to be of multivane design, single width, single inlet and overhung on an extended motor shaft. Fans and motor bases for exterior work or in toilet spaces or elsewhere subjected to dampness, must be watertight, with all joints between plates and angles to have tarred paper gaskets. All casings and motor bases are to be painted inside with asphaltum paint, outside to be left raw steel and have one coat of linseed oil, to be painted as specified, after installation. Fan wheels to be painted all over with asphaltum paint. All motors to be wound for 110 volts direct current and all watertight motors to have screwed caps on end of bearings fastened with short length of chain to a fixed part of motor. The bearings to be fitted with oil-tight gages, with normal level one-half way up on glass. Covers to be fitted with rubber gaskets. A glass must be fitted in the end cover of these motors to allow observation of commutation without removing cover and destroying gaskets. These glasses are to be protected by a swinging brass cover. All watertight motors must be fitted with watertight terminal boxes. All outside

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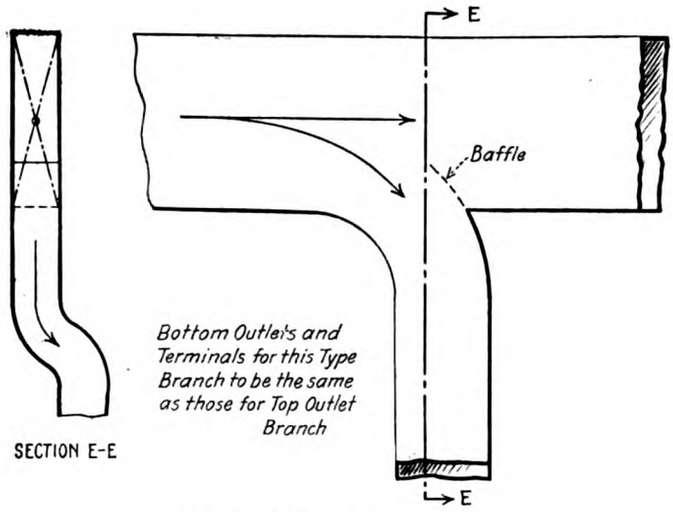

Fig. 4.—Side Outlet Branch

and inside fans to be marked by brass stamped plates, showing capacity, revolutions per minute and spaces ventilated. The intakes of all supply fans and the outlets of all exhaust fans to be provided with suitable sheet iron hoods (but not less than number 16 galvanized sheets), turned down to prevent rain, etc., from getting into fan. All hoods are to have heavy galvanized wire screens, one-half inch mesh, over openings."

DUCTS

"All new ducts to be of number 18 and number 20 galvanized sheet iron or steel, to be generally of rectangular section, flush inside with outside seams and as free from sharp bends as possible, the radius of bends to be 1½ times the width of duct where practicable. Where branches are taken off, the mains are to be suitably reduced in area by tapered section having a taper of 1½ inches per foot of length. Fore and aft ducts are to be led directly under the beams and athwartship ducts are to be led between beams, where practicable, in order to give maximum head room. Ducts to be securely supported at intervals, not to exceed five feet. Under no condition shall the steel structure be cut for vent ducts without written authority of the owner's representative. Vent ducts, branches, inlets and outlets shall be of such size and type as to afford the respective changes of air specified and the change of air in each room shall not

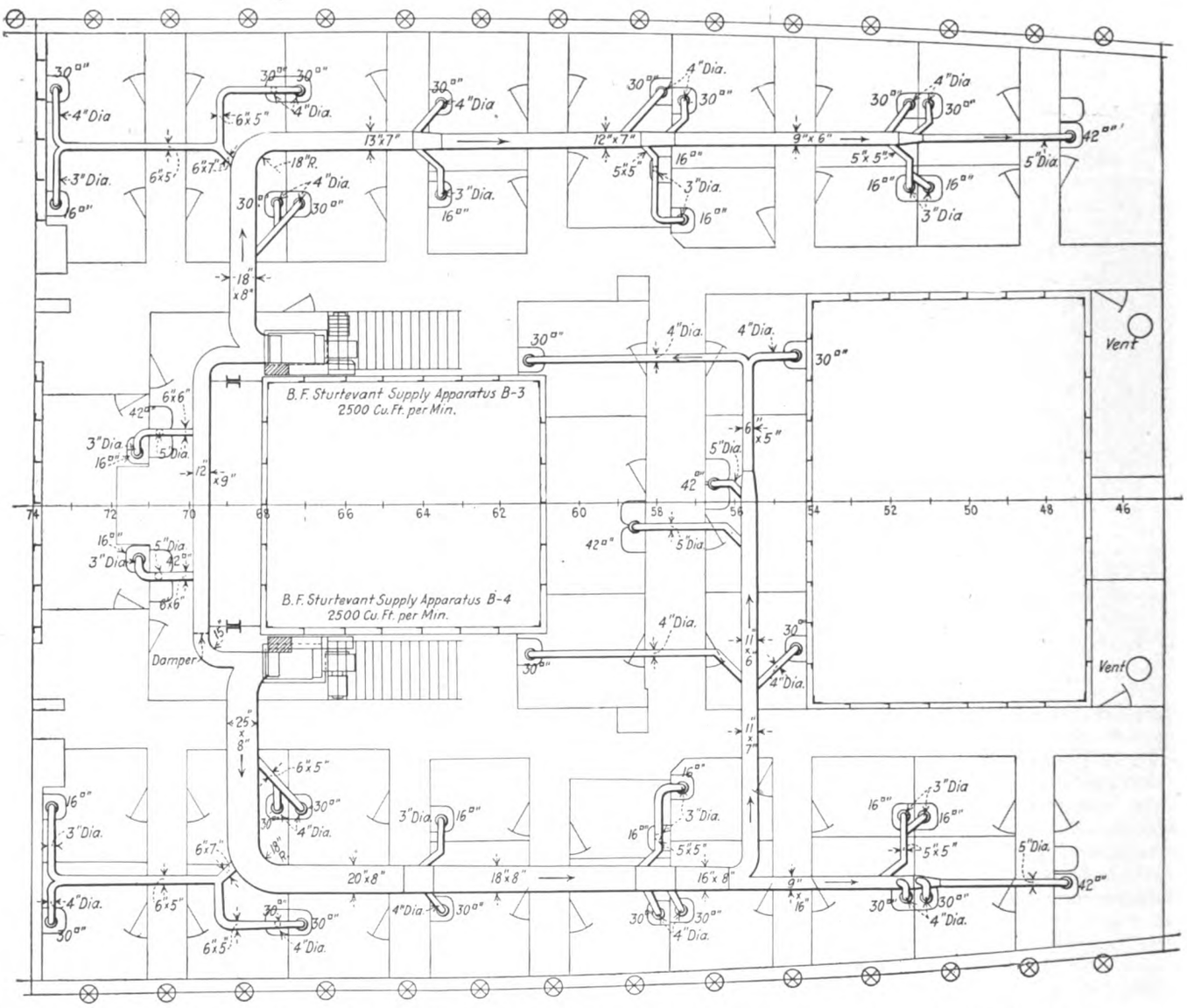
B.F. Sturtevant Supply Apparatus B-3 2500 Cu.Ft. per Min.
B.F. Sturtevant Supply Apparatus B-4 2500 Cu.Ft. per Min.
Damper
Vent
Vent

Fig. 5.—Mechanical Supply and Natural Exhaust System in Third Class Accommodations of S. S. President Polk

All areas of outlets in staterooms are the net areas through the outlets. All supply outlets to have round outlets with damper and to be carried down over the lavatory to within a height of 7 feet 2 inches above deck. Cubic feet per minute for 2 persons, 60; for 4 persons, 120; for 6 persons, 180.

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be less than that specified. When an air duct passes through a deck, a coaming shall be built of ten-pound plate with three-inch by three-inch by ⅜-inch angle collars riveted to the deck and the coaming calked and made watertight; this coaming shall be at least three feet in height above deck and extend below deck sufficiently for attachment of duct."

DEFLECTORS

"Deflectors and baffles of galvanized sheet steel, fastened to deck or bulkhead structure by means of galvanized flat bar hangers are to be fitted to insure passage of air clear of any individual berth. Where cowl vents lead into passages, deflectors or short lengths of ducts shall be fitted to send air along passages. An adjustable baffle shall be installed wherever required to equalize distribution at terminals."

"Each supply outlet except in crew's quarters is to be provided with a brass register or louver of approved design. In crew's quarters the outlets will be fitted with flared outlets and suitable dampers. All exhaust inlets are to be covered with galvanized wire screens one-half inch mesh, made readily removable for cleaning. These inlets are not to be provided with dampers or louvers."

COWL VENTS

"After all ventilation work is completed, each cowl shall be marked by a brass stamped plate showing number of system and space ventilated. The outlets and inlets of mechanical systems shall be marked in a similar manner. The natural vents are not to be connected to the mechanical systems. The numbers on the mechanical exhausts and intakes must correspond to the numbers on the fans connected therewith."

The Second International Shipping Conference

Delegates from Fourteen Maritime Countries Meet in London—Wide Range of Topics Discussed

By W. H. Wendon

THE second International Shipping Conference has taken place in London, and much good, it is hoped, will result. Many thousands of words were spoken by the delegates of the fourteen maritime nations represented, for the agenda was of considerable length, and, moreover, embraced a wide range of subjects. It is, therefore, hardly to be expected that the beneficial outcome of the gathering will be immediate; months may, in fact, pass before such is the case. But this much may be said: The conference was convened and conducted under homely conditions and, in view of the cosmopolitan nature of the assembly (the countries represented were, in addition to Great Britain and the United States, Australia, Canada, Belgium, Denmark, France, Germany, Holland, Japan, Norway, Spain, Sweden and Italy), the atmosphere which surrounded the proceedings was remarkably cordial.

It will not be beside the point to reiterate the remark of Sir Alan Anderson, the British shipowner who presided over the conference, that, while they could not claim for the conference the power to work a miraculous cure of bad trade and unemployment, or even at once to enforce their views on international trade, for the shipowners of fourteen great maritime nations to discuss together their common problems as if they were members of one family, and to agree together to give common advice, each to his own government, was in itself a hopeful sign of spring "after this long winter of their discontent." And on that ground of public policy the delegates to the conference were welcomed as heralds of better times.

It is not proposed to dwell at length on all that took place at the conference, but salient points may, and should, be emphasized. The question of flag discrimination occupied a prominent place and it was not contradicted (to quote Sir Alan Anderson) that "no one need speculate on the result; flag discrimination is a dangerous and contagious disease, and its risks have been fully explored by many nations in the past centuries."

COMPULSORY PASSENGER INSURANCE

The subject of compulsory passenger insurance is another of the outstanding subjects which were discussed by the delegates at the International Conference. Sir Norman Hill, vice-president of the Chamber of Shipping of the United Kingdom, and vice-chairman of the conference, led the debate with a reminder that this question was discussed in a preliminary way at Gothenburg last August at a meeting of the International Maritime Committee. He did not think it could be pretended that in equity the shipowner could be called upon to insure the passengers he carried against death or disablement resulting from risks and chances over which the shipowner had no control, directly or indirectly. In his view the question was one of practical and pressing importance and in its adjustment and settlement they, as shipowners, were directly concerned. While appreciating that the subject seems to be one of great difficulty, British shipping opinion undoubtedly inclines to the view that, if it is considered to be in the interest of a passenger or emigrant that he or she should be insured for a certain amount, the matter is quite easy to arrange through the customary channel, i.e., for an insurance company to take over the liability, without the suggestion being made that the shipowner should carry it.

TAXES ON FOREIGN SHIPS

The question of double, quadruple, and so on, taxation has long been a thorn in the side of shipowners, and they have attacked it from many angles. But their anger, tinged with anxiety, has seldom been so marked as in the case of the tax which for some months has been levied on foreign ships by the Spanish authorities. This tax, as is now pretty widely known, originated from the desire of the Spanish government to compensate Spanish shipowners for the losses which, so it was alleged, they had suffered owing to the requisition of vessels during the great war.

From fully authenticated figures which I have seen, however, far from losses being sustained by Spanish shipping people during the period under review, the very reverse was the case. One Spanish shipping concern, for example, distributed in dividends, in the war years 1916, 1917 and 1918, 30 percent, 75 percent and 50 percent respectively; a second company paid 79, 40 and 40 percent respectively; a third, 150, 180 and 520 percent; a fourth, 85, 75 and 355 percent; a fifth, 100, 110 and 100 percent; and a sixth 80, 90 and 150 percent. With the knowledge that such handsome returns were made in years which are alleged to have been lean ones, it is, perhaps, scarcely surprising that British shipowners, in the interests of themselves as well as of others,

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have taken every possible step in order to secure the abolition of this tax.

RECIPROCAL TAX EXEMPTION PROPOSED

Apropos taxation, the views of shipowners on this matter have undergone little, if any, change. Lord Kylsant, head of the "Royal Mail" group, has been a particularly doughty opponent of taxation abroad, so that his views at the recent annual meeting of the "parent" company are all the more noteworthy. At the corresponding gathering a year ago he referred to the offer by the United States Government to exempt from taxation the ships of those countries which were willing to extend reciprocal exemption to American ships, and expressed the hope that the British Government would take advantage of this offer by introducing into the Finance Act of 1923 a "reciprocal exemption" clause. This, of course, is now an accomplished fact; moreover, as Lord Kylsant has just pointed out, negotiations with the United States for the effective application of this clause are now in progress and it is universally hoped that they will reach a successful conclusion.

Unhappily, "multiple taxation" tends to increase rather than diminish. Lord Kylsant voiced the representative United Kingdom shipping opinion when he said: "The imposition of taxation by any country against the earnings of ships of other countries calling at its ports is extremely onerous, as no company carrying on business with many parts of the world can be certain where its liabilities for taxation end."

INFLATION OF SHIPPING CONCERNS

An echo of the great boom of a few years ago has just been heard at the Cardiff Bankruptcy Court. Mr. C. B. G. Hancock-Bell, whose finances were being inquired into, told how, together with some eight others, he went into shipping in 1919. His capital was £1,000, but the syndicate purchased the steamer *Campus* for £130,000, Mr. Hancock-Bell paying a deposit of £13,000. Later, the steamer *Sahara* was acquired for £98,000, the money, as in the case of the first boat, being raised from a bank upon Mr. Hancock-Bell's own security and signature. The next move was to form the St. David Steam Navigation Company, Limited. This was a public concern, and of the 200,000 shares Mr. Hancock-Bell took 590. With a slump in values, it was inevitable that there must be a crash. This, of course, is one of many similar instances, but what amazes one more than anything else is that banks, with the vast financial knowledge at their command, should have lent so wholeheartedly in this and other instances on the slender security tendered. The banks have, of course, burnt their fingers badly in consequence of these shipping boom transactions, and, if the whole of the truth could be told, the magnitude of the figures involved would undoubtedly be astounding.

COST OF FUEL OIL BIG FACTOR IN MOTORSHIP DEVELOPMENT

British shipowners are tending more and more to the adoption of the motorship as the vessel of the future, and influential names have gone to swell the list of those with the courage or enterprise to try out one or more boats of this type. But there have been knotty problems to solve all along the line, not the least of which, not so long ago, was the question of the adequacy of fuel oil supplies supposing that motorships were thrown into service on anything approaching a magnificent scale. Experts declared that there was nothing to fear in this connection and for a time shipowners rested more or less content. But with increasing costs of fuel oil, owners are again disturbed regarding the future. At the moment, this question of cost may be said to be the most weighty factor militating against the more general adoption of the motor vessel. To quote Lord Kylsant: "Shipowners who decide to have their vessels fitted with internal combustion engines have to face the risk of the advantages of the motor vessel being largely negatived by possible advances in the cost of oil fuel. The considerable rises that have taken place in the cost of oil fuel have attracted the attention of shipowners to what they may have to face in years to come if motor vessels should increase considerably in number, unless new large oil fields are opened up or British scientists find some way of economically extracting oil from coal or from some other British commodity." That, in a nutshell, is the position as most British shipowners see it.

PORT FACILITIES COMMITTEE REPORTS

Following its six months' investigations and deliberations, a committee set-up to inquire into the alleged lack of facilities at ports of the United Kingdom has "reported" to the extent of some 20,000 (twenty thousand) words; so that it cannot be said that the members of the committee have treated with any disregard the complaints made by Continental and Scandinavian shipowners towards the end of 1923 that United Kingdom ports were in a more or less chaotic and antiquated condition. About thirty ports were visited by the committee and its sub-committees, and the opinion of Sir Frederick Lewis, the committee's chairman, is that the criticism of the foreign shipowners has been partly, but not entirely, justified, he incidentally remarking that he did not want it to be supposed that there was no room for criticism of foreign ports.

Reviewing the work of the committee, Sir Frederick Lewis points out that, in fairness to the port authorities, it should be remembered how great were the difficulties with which they had to contend during the war, when they were particularly occupied with naval and military work and it was impossible for them to develop or even to maintain their property in an efficient condition. After the war it would have cost them probably 200 or 300 percent above pre-war prices to carry out improvements. Already, however, the setting-up of this Port Facilities Committee has had beneficial results in the matter of bringing about improvements, while there is reason to believe that similar schemes of an extensive nature are seriously contemplated.

SALVAGE COMPANIES FACE LEAN YEARS

Salvage companies formed in the past few years have experienced an astonishingly lean time. Losses have, with almost negligible exceptions, been the rule. Perhaps the most noteworthy instance of this lack of prosperity is afforded in that of the Ocean Salvage and Towage Company, Ltd., whose proprietors have now decided to "cut" their losses by writing down their share capital from £800,000 to £195,000, or a slash of £605,000.

Times are now regarded as more propitious for the company—certainly they could scarcely be less favorable than in the immediate past—particularly seeing that, by linking up with the "Neptun," of Stockholm, Sweden, a formidable competitor has been brought into the family circle, as it were. Consequent on the emphatic recommendation of some of the shareholders in the "Ocean" Company, the appointment of one of their number as a director is foreshadowed, and by this means the proprietors hope to "ginger-up" the directorate as a body by bringing strong pressure to bear on Lloyd's committee, whose views on the general subject of remuneration for salvage services are declared to border on the niggardly.

TRANSFER OF GOVERNMENT DOCKS.—According to an announcement made by Secretary Weeks, the government docks at Norfolk, Va., are to be transferred to the Shipping Board under an executive order to be issued shortly by President Coolidge.

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Shipping Board Selects 12 Vessels for Conversion

Advisory Committee Considering Types of Diesel Engines Best Suited for Installation in Government Vessels—$25,000,000 Available for Work

By Harold F. Lane

WASHINGTON, D. C.

FOLLOWING the signing by the President of the bill introduced in Congress by Representative William S. Greene, chairman of the House committee on merchant marine and fisheries, providing that part of the Shipping Board construction loan fund may be used to install Diesel engines in a number of government-owned merchant vessels, plans are being made at the Shipping Board to go forward with the work.

The Greene bill amended Sections 11 and 12 of the Merchant Marine Act of 1920. Section 11 originally provided for a "Construction Loan Fund," derived from the proceeds of sales and liquidation of Shipping Board plants, vessels and surplus materials, at the rate of $25,000,000 per year up to a maximum of $125,000,000 to be loaned at nominal rates to nationals for the construction in domestic shipyards of vessels equipped with the most modern and efficient machinery and appliances. As now amended this section will also permit lending one-half the cost of equipping vessels already built with the same kind of machinery, which in reality means internal combustion engines and electric driven auxiliaries.

Under this section approximately $67,000,000 has been accumulated; and Section 12, as now amended, allots $25,000,000 of this fund to the Shipping Board for a similar rehabilitation of its own vessels.

According to a statement issued by Chairman O'Connor of the Shipping Board, after a comprehensive study and survey of the board's idle fleets, about 375 vessels were selected as most suitable for a rejuvenation of their machinery with modern Diesel propelling power. "This class," he said, "offers a wide range of types and sizes and includes well preserved hulls of good design but fitted with machinery requiring extensive alterations in varying degree. Its replacement with improved steam machinery would undoubtedly enhance reliability and also economy to a lesser extent, but the resultant benefits would be quite incommensurate to the cost involved, and these vessels, not being marketable in their present condition, might be doomed to ultimate decay.

"Once, however, their motive power is replaced with modern and reliable Diesel machinery, they should prove competitive and valuable additions to the American merchant marine. Admittedly the cost will be high, but it should be remembered that a motorship generally consumes, when at sea, but one-third and when in port but one-tenth of the fuel burned by a sister steamship of equivalent power. This saving in fuel, plus that accruing from reduced engine room personnel, and consequently a reduction in wages and subsistence has been found in practice to absorb the cost of conversion in a period of from six to seven years. If the greater potential earning power of the converted vessels, by reason of their enhanced cargo carrying capacity, is taken into account, this time would be accordingly reduced.

"It is well to note that the board's vessels are now about five years old as an average, and fairly well preserved; once they are thoroughly overhauled they might be considered as good as new. Machinery, however, deteriorates faster than a steel hull, this being particularly true of a steam plant in view of the ever increasing number of new and converted motorships. Therefore, even with unavoidable improvements in the Diesel art, at the end of six or seven years a converted vessel would be more desirable and possess a market value proportionately much greater than as a steamer.

"According to the latest statistics of Lloyd's Register of Shipping approximately 50 percent of Great Britain's cargo fleet is composed of steamers over ten years old, or practically obsolescent, whereas about 85 percent of the United States total tonnage is from five to ten years old, which means that at the present time we hold a preponderance of approximately 3,000,000 gross tons of the newer vessels.

"Faced with the alternative of disposing of these deficient steamers in a constructive manner or of relegating them to the scrap heap, some three years ago the Shipping Board adopted the policy of selling these vessels at a nominal price providing they were converted to motorships in an acceptable manner. Thirteen vessels have already been so disposed of and are now engaged in transporting American goods. From present indications American shipowners are keenly alive to these vessels' potential possibilities and under the stimulus of the substantial loans made possible by Section 11, as amended, further conversions are anticipated.

"As regards the fund of $25,000,000 rendered available for conversion of the board's own steamers, it should be noted that its judicious expenditure over a period of years should effect the conversion of about 60 large vessels aggregating approximately 600,000 deadweight tons. These units will not only provide much needed replacements, but will also prove formidable competitors for the eventual expansion of our trade."

As the first step towards the consummation of such a comprehensive program the board has tentatively selected 12 vessels of the 8,800 and 9,400 deadweight ton type to be propelled by a single engine of approximately 2,600 shaft horsepower in order to obtain an average service speed of 11 knots, fully loaded, which is considered the minimum speed desirable in view of the forthcoming competition from the faster and newer foreign motorships. As soon as completed, these vessels are to be actively engaged on the essential long-distance routes. The introduction of motorships in such trades should more readily develop them into desirable and remunerative ventures, and make possible their eventual absorption by private capital; in the interim the board would effect substantial savings in operations.

To assist the board in this important task of selecting the engines considered most suitable, an advisory committee has been convened at the request of Admiral Benson and met in Washington on June 19.

According to the views of the Shipping Board's experts, the highest engineering standards will prevail through the complete Diesel installations: to this effect electrically operated auxiliaries of modern, simple and rugged types will be extensively used. The selection of main and auxiliary machinery will also be done with a view to standardization in order that high grade equipment may be procured at reasonable prices.

This policy should greatly assist the development and establishment of the related industries for as soon as standardized sizes are manufactured in greater number lower production costs will necessarily follow. This should further stimulate the conversion of the board's vessels by private capital under the construction loan policy as well as the con-

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struction of motorships of greater speed and special types, which are not to be found in the board's tonnage built to a comparatively narrow range of sizes and speed.

The combined effect of this new legislation and the board's policy of selling Diesel hulls at nominal prices, as well as by the stimulus of the board's correlated program, the board believes, should enable private interests to convert these steamers into efficient motorships at somewhat lower cost than equivalent foreign tonnage.

The advisory committee, which is to assist the board in selecting the proper types of Diesel engines and in other matters pertaining to the contracts, consists of Rear Admiral Hutch I. Cone, executive assistant to President Palmer of the Fleet Corporation, chairman; Angelo Conti, consulting engineer of the board, secretary; Major W. D. Styer, of the engineer corps, U. S. Army; W. F. Gibbs, president, Gibbs Bros., Inc.; Commander S. M. Robinson, of the bureau of engineering, U. S. Navy; John F. Nichols, chief engineer Newport News Shipbuilding & Dry Dock Company; and C. A. McAllister, vice-president American Bureau of Shipping.

REVISED TERMS OF PAYMENT FOR GOVERNMENT SHIPS

The Shipping Board has authorized a revision in the standard terms of payment in connection with the sale of ships. Under the revised terms, when satisfactory credit standing is established, payment for vessels may be made as follows:

"25 percent cash, balance in 10 equal annual payments with 5 percent interest payable semi-annually, secured by first preferred mortgage.

"Terms of payment not exceeding five years for the sale of Lake-built vessels.

"Interest at rate of 4½ percent when vessels are purchased under contract guaranteeing restricted trade route operation.

"The foregoing terms will be placed into effect immediately."

INVESTIGATING COMMITTEE TO VISIT EUROPE

Members of the select committee of the House of Representatives which has been conducting an investigation of Shipping Board affairs have announced the intention of spending five or six weeks in Europe this summer for the purpose of examining conditions under which American shipping operates abroad. According to a statement issued by the committee, if it is to be able "to make a comprehensive and constructive report upon which Congress may later base legislation necessary to the establishment of a successful merchant marine, it seems necessary that the committee get its information by inquiry in the home of foreign opposition." Reservations have been made on the *George Washington* for July 4 for several members of the committee, Commissioners Plummer and Haney and several officials of the Fleet Corporation.

STUDYING SECTION 28

The special committee on co-ordination of rail and water facilities recently appointed by President Coolidge is making a study of Section 28 of the merchant marine act, the operation of which has recently been again suspended, with a view to making a report of all the facts in connection with possible application of the section at some future time. The committee is having its experts examine the information developed as the result of the proposal to apply it earlier in the year which developed so much opposition. It is thought possible that the committee may make findings which will lead to legislation amending the section. Congress took no action before the adjournment on June 7 either on the bill providing for the postponement of the effective date of the section or the resolution providing for the appointment of a special commission to study the entire question.

DECK BOYS FOR GOVERNMENT VESSELS

Carrying out the recently adopted policy of the Shipping Board for the employment of deck and engine room boys on board government-owned vessels, the following instructions have been sent to district directors of the Fleet Corporation and masters of vessels:

1. To make it possible for Americans to enter the sea profession, there will hereafter be carried on all Emergency Fleet cargo vessels two deck boys, who will replace one of the ordinary seamen now included in the authorized crew lists. They will be signed on articles, receive subsistence, and be quartered the same as other members of the crew.

2. Deck boys must be American born, or those who, under the provision of the law applying to minors, are naturalized through their parents.

Deck boys must be under twenty-three years of age and of good physical and moral character. The minimum age is fixed at eighteen but the physical and mental development of boys of that age will be considered as a factor in making appointments. Minors must have the consent of their parents or guardians.

3. Masters and officers will appreciate that the primary training of seamen is of great importance and will largely influence and affect the ultimate success of the merchant fleet, and that well trained and experienced seamen are essential to the national welfare in emergencies requiring increases in the personnel of the armed forces, transports and supply fleets. The Americanization of the merchant fleet makes obvious the need to create a way for American boys to begin a sea career, which has been difficult in the past.

4. Upon masters and officers is imposed the duty of training deck boys and laying the foundation of discipline, essential to the successful development of efficient seamen. Their training will be such as to fit them for the higher ratings of ordinary and able seamen and, as experience and ability are acquired and developed, for ratings of petty officers and higher.

5. The ground work is of the highest importance, and masters and officers will seriously regard the duties imposed upon them of insuring the training of boys in seamanship, cargo work and the care and upkeep of the modern steamship. The condition of cargo spaces, maintenance of ship's structure, expenditure of stores, the care of the cargo itself, are all recognized elements in the success of cargo carriage, for which purpose ships are constructed and operated, and it is desired and expected that the instruction and training of boys will include all of the essentials noted above, as well as in rope work and other features of seamanship included under the interpretation of "hand, reef and steer," as far as it applies to present day power vessels.

CONSOLIDATION OF GULF SERVICES

The Shipping Board at a meeting on June 19 approved with some modifications a plan submitted by President Palmer of the Fleet Corporation for a consolidation of the freight services to and from Gulf ports, along the lines of the consolidations already effected in the North Atlantic and Scandinavian services, on a tentative basis for six months. Under this plan the number of operators is to be reduced from nine to seven by the elimination of Page & Jones and a combination of the S. Sgitcovich and Trosdal, Plant & Lafonta companies, but the board did not approve of any reduction in tonnage.

The rearrangement and consolidation of the service is to involve the use of the new form of managing operator agreement recently applied in the North Atlantic and Scandinavian consolidations; the percentage of commission in the new contract to be not in excess of 7½ percent on outward or 3 percent on inward gross cargo. All the provisions contained in the board's resolution of November 30, 1923, as recommended and applied in the North Atlantic consolidation, are to be made immediately applicable to the Gulf services. During the six months period monthly reports are to be made to the board concerning the operations of the respective agents under this new arrangement, and then further recommendations will be made based on developments as shown by these reports.

According to a statement issued by T. V. O'Connor, chairman of the Shipping Board, a total of more than $5,000,000 has been loaned by the Board for the construction of American flag tonnage under the provisions of the Shipping Act of 1920, as follows: $400,000 to the Minnesota Transit Company, Duluth, Minn.; $2,666,000 to the Cherokee-Seminole Steamship Corporation; $1,000,000 to the Robert E. Lee Steamship Corporation, and $1,500,000 to the Coano Steamship Corporation, a subsidiary of the New York and Porto Rico Steamship Company.

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A New Double-Acting Diesel Engine

Werkspoor Company Develops Novel Four-Cycle Type— Is Prepared to Build Engines of 8,000 Brake Horsepower

By Our Special London Correspondent

MANY of the leading European Diesel engine builders have become convinced that the future of the motorship lies with the employment of double-acting machinery, and a great deal of energy is being expended upon the production of suitable types. The first North British double-acting two-cycle motor is now being installed in a ship, and three more are under construction. Within the next few months, the first 6,750 brake horsepower double-acting Burmeister & Wain four-cycle engine will be completed, and Harland and Wolff, at Belfast, are building sets of still larger power. In Germany, the Maschinenfabrik Augsburg Nürnberg have run trials on a single cylinder 1,000 brake horsepower double-acting two-cycle machine, while the Fiat Company, at Turin, will shortly produce an engine of equal power, also operating on the two-cycle principle.

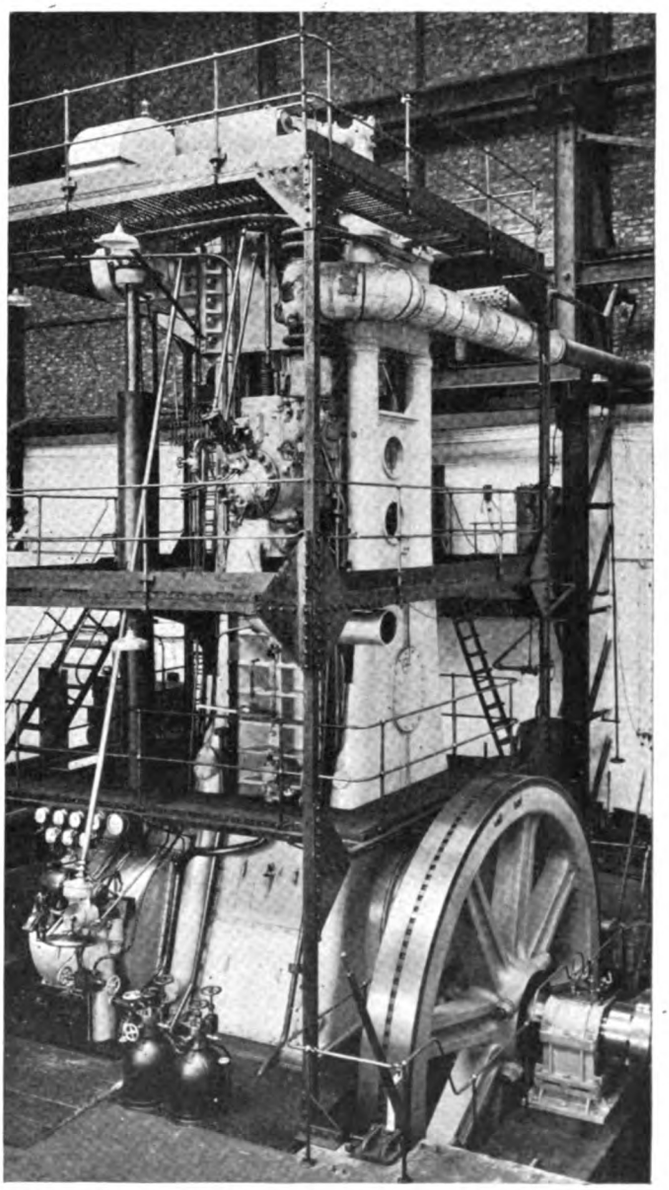
It would appear that competition will now arise between the four- and two-stroke double-acting motors, just as in the past it has been experienced in the single-acting design. Manufacturers, like Burmeister and Wain, who have concentrated wholly on four-cycle machines, are employing the principle, when proceeding to the employment of double-action, and the same policy is to be noted in connection with the new Werkspoor four-cycle double-acting engine, which has just aroused the greatest interest in engineering and shipbuilding circles in England. The first unit has been built by the British licensees of the Werkspoor Company, the North Eastern Marine Engineering Company, and is a single-cylinder set developing 600 brake horsepower at 95 revolutions per minute. This is equivalent to about 750 indicated horsepower but a maximum of 1,000 indicated horsepower has been attained. It has a cylinder bore of 800 millimeters, or 31½ inches, and a stroke of 1,400 millimeters, or 55 inches.

Stuffing Box Arrangement

Some very ingenious arrangements have been adopted by the designers in producing this new engine. Their first aim was to avoid any possibility of trouble with the piston rod, where it passes through the bottom cylinder cover. With this in view, they have arranged the lower combustion chamber to project horizontally from the cylinder cover and to be connected with the cylinder by means of a large port. The inlet and exhaust valves are arranged vertically in the combustion chamber, one at the top and one at the bottom, while the fuel valve is at an angle of 45 degrees and the starting valve horizontal. By this means, all valves are eliminated from the cylinder cover itself and the combustion of the fuel takes place at some distance from the piston rod. The temperature of the latter is, therefore, maintained at a relatively low level and no trouble is experienced with the stuffing box through which it passes in the cylinder cover.

Another notable feature is the fact that in the lower half of the cylinder, below the piston, the compression pressure is not the full Diesel pressure of 500 pounds per square inch, but only about 250 pounds per square inch. The temperatures are therefore quite moderate, and although this involves a reduction in the power that would otherwise be possible, the difference is not very substantial, in view of the advantages attained.

So far as the upper portion of the cylinder is concerned, this follows along ordinary four-cycle single-acting practice, with all the valves arranged in the cylinder head, these being operated from cams from an overhead camshaft which also actuates the valves in the lower combustion chamber. It will be obvious, however, that with the low compression pressure at the bottom of the cylinder, the fuel would not ignite if injected into the combustion chamber when starting up. During the starting period, therefore, the engine is operated as a single-acting machine, and the lower portion is heated up by allowing the exhaust gases from the top to enter the cylinder at the bottom through the exhaust valve, which is maintained open for about five minutes. After that time, the temperature has risen to the required figure, namely, about 450 degrees F., and fuel can then be admitted so that the en-



The New Single Cylinder 750 Indicated Horsepower Werkspoor Double Acting Four Cycle Diesel Engine

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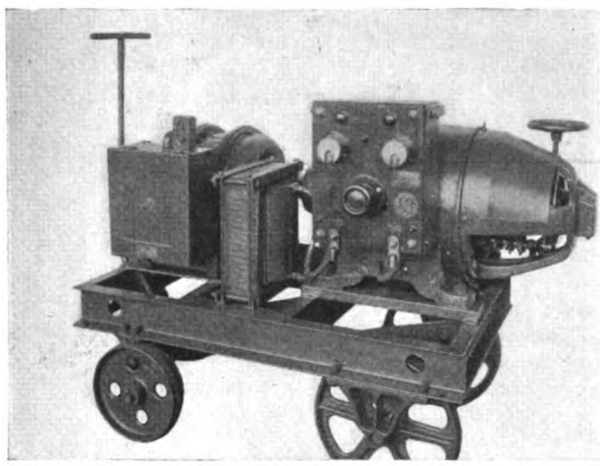
gine is working as a double-acting motor. The necessary control is simply effected from an electrically operated starting and maneuvering mechanism, which is, of course, quite automatic.

In other respects, the general construction of the engine presents no special peculiarities. The combustion stresses are taken by long steel tie bolts, which extend from the top of the upper cylinder cover to the bottom of the bedplate, these bolts being arranged within the cast iron framing. The camshaft is driven from the crankshaft through bevel gearing and a vertical shaft. In reversing, the well-known Werkspoor system is employed, of giving skew motion to the valve levers so that the rollers at the outer end of the levers come above the astern cams. It is claimed, therefore, that there is very little that is experimental in this new design, and the builders are quite prepared to construct eight cylinder engines of 8,000 brake horsepower. It is understood that an order for a big ship equipped with this class of machinery will shortly be placed.

Portable Arc Welder Adapted to Short or Long Leads

A PORTABLE arc welder, capable of delivering continuous power and permitting rapid production, with either high current and large electrodes, or low current and small electrodes, has been put on the market by the General Electric Company, Schenectady, N. Y.

This welder is a two-unit set, consisting of a motor and a generator. The generator is self-excited, thereby eliminating the necessity for a separate exciter. All regulation of



New General Electric Portable Arc Welding Generator

current is accomplished by turning a hand wheel on the generator. A self-adjusting, stabilizing reactor is provided, which automatically steadies the arc under all welding conditions.

The machine can be used with any of the commercial sizes of metallic electrodes, from 1/16 inch to ¼ inch in diameter. Generator voltage can be adjusted to suit the character of the work. High voltage for complete penetration on heavy work and low voltage to prevent burning through on light work are thus secured at will. Any value of current between 75 and 300 amperes can be obtained in a large number of steps between these limits.

Among the operating advantages claimed for this outfit are: An arc easy to start and maintain, roller bearing wheels, holes in base for crane hooks and adaptability to long or short leads, for working close by or at a distance from the set. Among the mechanical features are included motor and generator insulation designed to withstand severe operating conditions under which ordinary insulation fails. The bearings are waste-packed and oil cannot be spilled if the set is tipped when being moved.

The generator is a two-pole, self-excited, constant-energy, single-operator machine, with a dual magnetic circuit designed to operate at 60 volts open circuit, and 20 to 25 volts under load. It is rated at 200 amperes for continuous service; 250 amperes for one hour, and 300 amperes for short periods. The motor is a standard General Electric 10-horsepower unit. The complete set has three bearings, the two units being close-coupled by a solid flange coupling. All parts including generator, motor, generator control panel, motor starter and stabilizing reactor, are mounted on a welded structural steel base of rigid construction and light weight. The assembled unit is about 63 inches long, 29 inches wide and 47 inches high, weighing about 1,600 pounds.

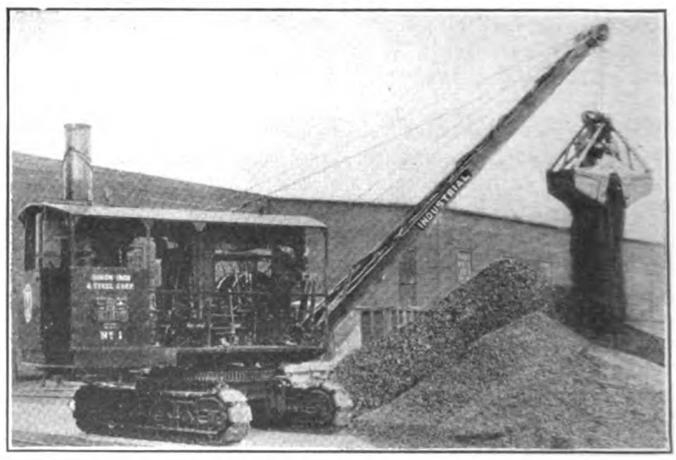
Ten-Ton Crawling Tractor Crane with Independent Control

THE new type "D" 10-ton crawling tractor crane, a new product of the Industrial Works, Bay City, Mich., has among other features an independent control of the traveling, slewing and hoisting motions. These motions may be utilized in a variety of combinations which are said to result in increased speed and efficiency of operation. For instance, the hoisting and slewing motions may be combined in bucket work for operation at high speed and when traveling, the boom may be swung in any direction to clear obstructions.

The entire upper works of the crane rest on a rotating steel base, which insures rigidity and perfect alinement. This base rotates on four conical steel rollers which are accessible and which may be taken out without removing any of the parts or jacking up the crane. Heavy steel side frames which carry the shaft bearings are bolted to this rotating bed. These bearings are arranged on the outside of the frames so that any shaft may be easily removed without displacement of other parts.

The crane has two traveling speeds and reversal of direction is accomplished by reversing the engine. Steering while propelling is accurately accomplished from the operator's platform through friction clutches and brakes controlling each tractor belt.

The new crane is built for either steam, electric or gasoline power. The steam crane has two horizontal, double acting cylinders 6 inch diameter by 8 inch stroke. The engine is equipped with a simple radial type reversing gear, by means of which loads may be lowered and the hoisting line paid out by power. The crane operates with clamshell or dragline buckets, electro-magnet, hook and block or grapple. It is readily convertible into a shovel or a pile driver.



Ten-Ton Crawling Tractor Crane

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Handling Fuel Oil Aboardship

Methods of Conserving Fuel Oil and Promoting Safety by Proper Storage and Pumping Facilities

By Joseph Hecking*

IT is one of the advantages of the oil-burning over the coal-burning vessel that the fuel may, to a large extent, be carried in compartments which are ordinarily intended for ballast. To sacrifice this advantage, that is, to provide separate compartments for the fuel oil and for ballast would diminish, if not nullify, the advantages of burning oil by requiring spaces which can more profitably be used for the carriage of cargo. Passenger ships in particular and cargo ships to a lesser degree require a fixed minimum draft for stability and in order to maintain this stability upon consumption of the oil fuel, the oil compartments are filled with sea (ballast) water. The thought suggests itself that the lines installed for the conveyance of oil be also used for ballast water, as far as practicable.

While the rules of the American Bureau of Shipping require that "the oil pumping arrangement must be distinct from the other pumping plant" this requirement is qualified by "the arrangements for preventing any dangerous exchange of pump lines must be thoroughly effective, particularly in cases where it is intended to sometimes carry oil fuel and sometimes water ballast in any of the compartments." In view of the fact that the separation of the oil and ballast systems cannot be made absolutely fool-proof, where either oil or water may be carried in the compartments connected to both systems, it is considered safer to combine the individual suctions from the various tanks into one or more common manifolds, having separate chambers for connections to the ballast and to the fuel oil transfer pumps. These two pumps should always be fitted, principally in order to keep the two fluids separate and secondly to serve as an emergency, one to the other. Where the ballast pump serves other purposes, such as emergency condenser circulating, sanitary, fire main, etc., special precaution must be taken to prevent coating the inside of the water pipes and condenser tubes with a film of oil, or oil getting into the fire main.

Correctly Designed Fuel Oil Systems Needed

UNSUITABLE storage and pumping systems for fuel oil in vessels have caused a waste of oil that is, to say the least, uneconomical in view of the threatened shortage of the oil supply. This waste oil has also aroused many protests from shore resorts where bathing beaches have been contaminated and from owners of docks who have objected to the increased fire hazard from oil-soaked piling. The designing engineer realizes fully the importance of adequate fuel oil pumping systems, both from the viewpoint of economy and safety, but in laying out the plans, the owner's and classification requirements are frequently considered secondary to the interests of the shipbuilder. Much ado has been made over the saving of one-tenth of a pound of oil per horsepower on trial trips but little attention is being paid to the pumping overboard of large quantities of oil from the lack of an adequate pumping system. Arrangements which have proved satisfactory and suggestions for improvements that may help to overcome the wasteful use of oil fuel are offered in this article for the consideration of all those interested in the promotion of economy in shop operation.

Combined Oil and Ballast Manifolds

In Fig. 1 is shown one unit of the commonly used plug cock manifold. The cocks have an open bottom for pipe connection to the tanks and a single side port which may be set to either the water or the oil chamber. The cock is made of bronze and where the manifold body is made of cast iron it is customary to fit a bronze liner. The packing consists of one bottom brass washer and about 6 vulcabeston rings. The gland is secured by not less than 3 bronze studs and nuts.

The plug cock manifold is simple in construction and is quickly operated, but the large bearing surface is difficult to keep tight and as a result most shipbuilders prefer to install the double-valve manifold, a unit of which is shown in Fig. 2. The manifold body only is shown since the valve mountings may be of standard type and dimensions, perhaps with an extra long valve stem, due to the increased depth of the chambers. The valve seats should be made separate and renewable owing to the erosive action of sea water and fuel oil. Two adjoining valves are connected below their seats to a common nozzle, which is piped to a tank, the manifold having a longitudinal partition to separate the two sets of valves and the fluids. The valve manifold is rather slow in operation and requires a complicated casting and many small parts.

Fig. 3 shows a suggested valve combining the quick operating advantage of the plug cock with the seating advantage of the valve. The floor space required for installation is considerably less than required for manifolds No. 1 or No. 2, in view of the fact that the ports are arranged in a vertical direction. With the lever locked in the lower position connection is made between the tank and the ballast pump; in the upper position between the tank and oil pump, and in the middle position both valves are closed. The outlets to the tanks may be bolted directly to the bulkhead, eliminating pipe connections in the engine or fire rooms.

Pumping Arrangements

Fig. 4 shows a complete pumping arrangement for oil and ballast. One of the chambers of the manifolds is shown connected to the suction and discharge of the ballast pump and the other chamber to the suction and discharge of the fuel oil transfer pump. It is often found that the two chambers of the manifolds are used, one for the suction and one for the discharge of both ballast and oil pumps. It will readily be seen that in changing from the oil to the ballast

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pump the large suction and discharge mains are filled with oil, which will have to pass through the ballast pump either overboard or into a tank containing water. In a similar manner the water in the mains will have to pass through the oil pump, when shifting from the ballast to the oil pump, either overboard or into an oil tank. In both cases a large body of oil may be pumped overboard or may become emulsified with salt water and unfit for use, every time it is

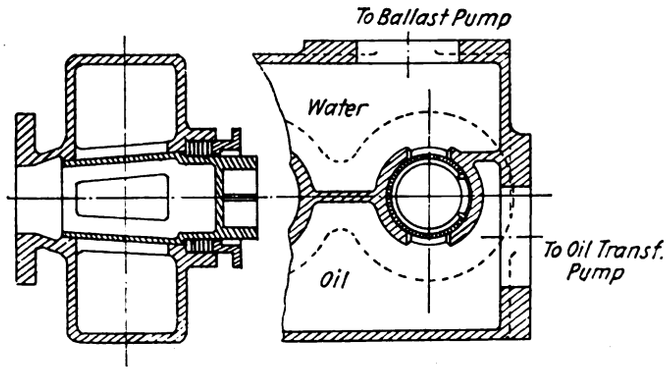

Fig. 1.—Unit of Plug Cock Manifold

found necessary to transfer oil or to fill an empty tank with water ballast.

A direction-manifold consisting of four valves is shown near both pumps, two valves connecting to the suction side of each pump and two to the discharge side. A two-valve manifold of the type shown in Fig. 3 will serve the same purpose. These valves enable the engineer to trim the ship by pumping oil or water at the same time from forward to aft and vice versa. Where no fuel oil tanks are located abaft the machinery space and where the number of tanks located forward make it desirable or necessary to trim the ship upon consumption of the fuel, the forward manifold should be divided so that oil may be transferred from the foremost tanks to the after tanks and vice versa. The rules of the American Bureau of Shipping require that tanks

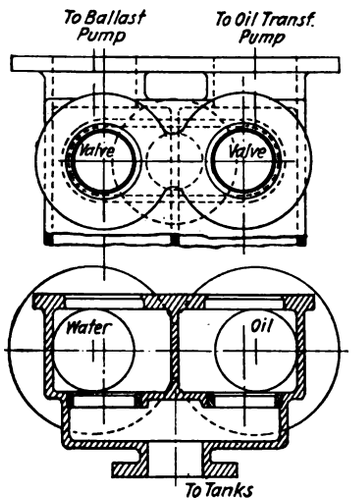

Fig. 2.—Unit of Double Valve Manifold

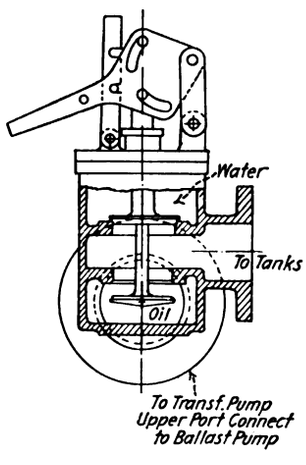

Fig. 3.—Proposed Valve

should be capable of being pumped with the vessel listing 15 degrees. This provision necessitates the fitting of two suctions in each tank, one near the centerline and one at the side, on both sides of the oiltight center keelson. Tanks at the extreme forward and after ends are usually narrow and have sufficient deadrise for only one center suction at each side. It is also not uncommon to make the center keelson in such tanks non-oiltight and provided with drain holes so that one center suction will suffice. Ships generally trim aft and the tank suctions are therefore fitted in the after ends of all tanks.

While it is less difficult to run the suction pipes from the manifolds to the various tanks on the top of the inner bottom, than through the double bottom, such pipes must be amply protected by strong casings from injury by cargo and it is,

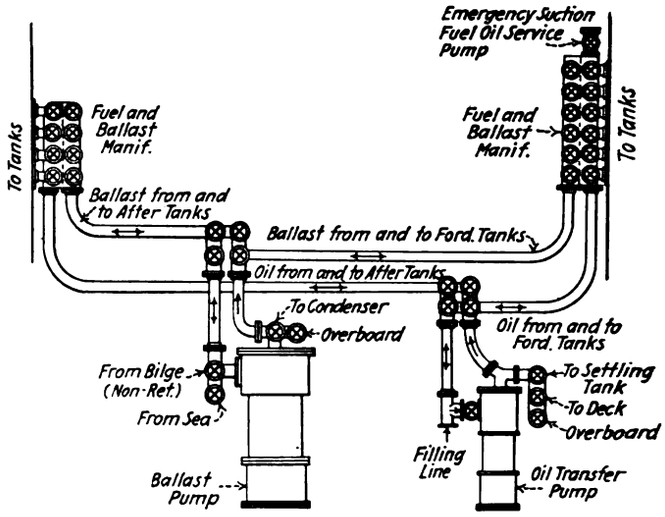

Fig. 4.—Complete Pumping Arrangement for Oil and Ballast

therefore, just as difficult to detect leaks as when run through the double bottom. There is, in addition the danger of damaging cargo by defective pipes when transferring oil or ballast. If properly installed in double bottoms with effective expansion bends between fixed points, the pipes should last a considerable length of time. Copper pipes should not be used for the conveyance of oil nor in oil tanks as experience has shown that the action of the oil, especially when heated, causes them to get brittle and to crumble.

Connections through bulkheads are best made with three flange steel bulkhead castings riveted to the bulkhead or secured with through bolts tapped into the plating. It may also be mentioned here that the United States Steamboat Inspection Service requires deck-operated valves in all deep tank suctions adjacent to the machinery space, located close to the bulkhead inside the tanks. The American Bureau requires valves to be located close to the bulkhead on the fire room side.

It is almost universal practice to make the branch pipes to each tank 4 inches in diameter, smaller sizes being unsatisfactory, especially where heavy oils are handled. Side or wing suctions may be made 3 inches in diameter, if the viscosity of the oil and the climatic conditions of the ship's route permit. The mains from manifolds to the pumps for ordinary cargo vessels are generally 6 inches for the ballast main and 5 inches for the oil main; larger ships have mains up to 10 inches for ballast and 8 inches for oil depending on the quantities to be handled for the effective trimming of the vessel.

The various connections shown in Fig. 4 require little explanation. The suction connection on the manifolds for the fuel oil service pumps serves as an emergency in case the oil transfer pump is disabled. A discharge connection from one of the service pumps to the settling tanks should be fitted, in view of the fact that the tank suctions lead within ½ inch from the bottom of the tanks and water and sediment may be pumped from the bottom of the tanks before the oil is sufficiently clean to be discharged into the burners.

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Tanks are filled via the fuel oil main and, when filling tanks, the deep tank controls in the manifold should be opened simultaneously with the control valves of the double bottom tanks, so that fuel double bottom tanks will overflow into the deep tank and not through the vent pipes overboard or on deck. In order to prevent excessive pressure on the deep tanks, overflow pipes are fitted to these tanks terminating at the side of the ship several feet above the deep load line with non-return valves at the ship's side. This is bad practice and in lieu an indicating float gear as is commonly fitted for deep tanks of Diesel-engined ships should be provided.

The prohibition of gage glasses on deep tanks by the United States Steamboat Inspection Service is entirely too sweeping and has led to more objectionable substitutes such as the above mentioned overflow. There is little doubt but that safe gages such as the Klinger glass type can be built in deep tank bulkheads adjacent to the fire room. Filling connections are frequently made to the deep tanks direct, whence the oil flows by gravity through the manifold to the double bottom tanks. The indicator arrangement should also be fitted in this case. Where the filling connections are made at a considerable height above the bottom of the deep tanks internal pipes leading to the bottom with a short horizontal section must be fitted in order to prevent damage to the bottom by the impact of the incoming oil when the tanks are empty.

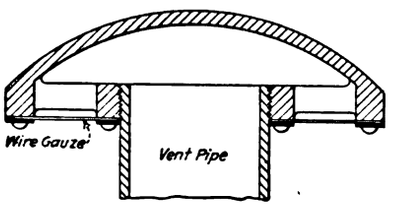

Fig. 5.—Air Pipe Terminal

Air Pipes

Air pipes should be fitted on both ends of each tank. In order to eliminate gas pockets, at least one pipe should be fitted near the center keelson and at least one at the extreme sides. This arrangement will prevent air pockets and permit the filling of the tanks to full capacity in case the vessel lists to either side. Based on relative velocities only the area of the air pipes could be made about one-fourth the area of the filling pipe, but when a tank is full the inertia of the viscous oil sets up additional pressures due to the kinetic energy of the velocity of the discharge before the oil rises in the vent pipes. In order to reduce these indeterminable pressures it is safer to make the air pipes of ample area, at least equal to the area of the filling line.

The main air pipe must be located at the highest part of the tank which is at the forward end, usually amidships. Smaller air pipes may be located at the sides and at the after end. Double bottom tanks have relatively small unsupported flat surfaces, but the decks over deep tanks have rather large flat surfaces and it is advisable to make the area of the air pipes equal to twice the area of the filling pipe.

At the upper terminal, air pipes are generally fitted with U-bends or double ells taking U form. The open end is protected by wire gauze in order to prevent fire on deck getting to the oil tank. Experiments have shown that a mesh of 40 wires per inch is necessary for perfect protection, but such fine mesh is rarely fitted and a 30 mesh is considered satisfactory. Too little attention is paid to providing ample area through the wire screening with the result that the opening of deck seams in way of deep tanks is a too frequent occurrence. The fine wire mesh gets clogged with heavy oil, also by corrosion or oxidation and requires frequent inspection and renewal; monel metal wire is the most suitable material for screening. In Fig. 5 the writer suggests an air pipe terminal which should fulfill all the essential requirements.

Sounding

On nearly all merchant vessels the ordinary sounding pipe, consisting of a 1½-inch or 2-inch pipe, a deckplate at the upper end and a guard yoke at the lower end (near the bottom of the tank) still prevails. The deckplates must be in always accessible places and where escaping gases can do no harm. In machinery spaces and in shaft alleys the pipes may terminate in gate valves or weighted pipe caps. In order to prevent the sounding rod from injuring the ship's bottom and thus accelerating corrosion, a doubling plate is sometimes riveted to the plating. It is, however, better and cheaper to fit the lower end of the pipe with a renewable steel yoke or an extra heavy malleable iron tee fitting having both ends open. Air holes are cut in the pipes on the under side of the tank tops. Sounding pipes constitute a crude and inconvenient form of sounding and are at times unreliable. Deterioration and leakage have caused considerable damage to cargo, to their discredit.

A number of ingenious devices have been developed, of which the Pneumercator is the best known and is fitted on all government vessels. The apparatus may be located in the machinery space in any convenient location, where the control system of a number of tanks is concentrated. It consists of a mercury gage indicating height and capacity of the liquid in the tank, a balance chamber in the bottom of the tank connected to the gage by a small size pipe, and a small hand air pump or other source of low pressure air supply. A number of tanks may be manifolded to one gage. In order to prevent the overflow of oil, especially when filling via deep tanks, an electric alarm-bell, making contact with the rising of the mercury in the gage at a predetermined level is furnished with the system. The apparatus is thoroughly reliable and easily operated. There are one or two other systems working on similar principles, but they are not sufficiently tried out to warrant their detailed description at this time.

Heating

Heating coils should be fitted in all oil tanks, especially in cases where low gravity oil is carried. They generally consist of a coil or coils located around the suction pipe in the case of light oils and a grid of pipes in the bottom of the tanks for heavy oils. Extreme care must be taken to allow for expansion in the steam line and if any screwed joints are located in the tanks they should be welded in addition. Pipes should be of seamless steel inasmuch as welded pipes of small sizes are butt-welded and not suitable for steam pipes subject to considerable water hammer. The steam control manifolds for the various tanks are located in the machinery space and in addition to the stop valve a non-return valve should be fitted in each line. The returns from the heating coils are led through steam traps to an open observation tank, whence the condensate is led to the filter side of the feed tank via a visible discharge and funnel. Where the discharges of several steam traps are combined into one main the connections should be made with Y fittings in order to avoid back-pressure on any of the steam-traps. Observation tanks should be made of ample capacity, so that when the steam-traps are by-passed a sufficient body of water remains in the tanks to condense the steam entering through the return pipe. In cold climates it is advisable to make a connection between the return pipe and the condenser in order to clear the coils of condensate which may freeze and break the pipes. Such connection must be made through a large air chamber fitted with a gage glass to indicate possible oil leakage into the system.

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PURIFICATION OF FUEL OIL

Ships coming into port discharge ballast water at sea and inasmuch as tanks cannot be pumped absolutely clear of fuel oil before ballast water is pumped into them, some oil and an emulsion of oil and water is pumped overboard. As a result, the oily surface of the water is causing alarm at sea resorts and to harbor authorities to such an extent that radical legislation is being proposed to remedy the menace. However, this question is not as much a matter of legislation as of engineering and should and will be solved in a satisfactory manner. It is absolutely certain that no ship operator will intentionally permit the discharge of considerable quantities of oil overboard and would be more than pleased if the problem could be solved. Inventors have lately given the subject serious consideration and various systems have been developed and demonstrated but without, as yet, sufficiently satisfactory results to warrant their installation, either aboard the ship or on the docks.

Through the courtesies of the De Laval Separator Company and the Standard Oil Company of New Jersey, the writer has had the opportunity to test the possibilities of the De Laval separator for the purification of fuel oil. A detailed report has been published in the November-December, 1923, issue of the *Bulletin of the American Bureau of Shipping*. Test No. 4, pertaining to the separation of fuel oil, ballast water and sediment, is of particular interest in this connection and is quoted from the *Bulletin* as follows:

"Test No. 4. Sample consisted of five gallons of ballast water taken from fuel oil tanks of steamship *Mongolia*. The whole quantity was poured into the drain bowl of the machine and almost immediately three gallons of clear water could be drained off without running the mixture through the machine. The remainder was heated to 103 degrees F. and run through the purifier, rendering about ¾ gallon of water with a light skim of oil, one gallon of an emulsion of sediment and water and fully ¼ gallon of oil. The redeemed oil had a specific gravity of 0.930 at 60 degrees F., corresponding to 20 degrees Baumé, and upon test in centrifuge proved 99 percent pure."

It will be noted that ballast water from fuel tank consists in the main of three elements which can be successfully separated, water, oil and sediment. The sediment forms only a small percentage except in cases where the tanks have not been cleaned for a considerable length of time, as the fuel oil delivered by the oil companies is practically pure. But the sediment is of nearly the same specific gravity as the water and has the characteristic of absorbing water to the saturation point. This can be demonstrated by spreading a small quantity of the mixture on a blotter, which will absorb the water and leave a thin layer, like paint, of the black substance, asphalt or free carbon, on the surface. Heating the mixture accentuates the difference in specific gravity of the sediment and water and causes the sediment to rise above the water. The test has also shown that with little time for settling and possibly slight heating, the water can be drained from the mixture without special apparatus, so that only a comparatively small quantity need be run through the purifier for separation. This fact has led the writer to suggest the diagrammatic arrangement shown in Fig. 6.

The ballast pump is to lift the water from the oil tanks to a settling tank, located above the ship's load line. In sea service this tank may be a part of the deep tanks connected to the same via deck sluice valve or it may be a tank independent of the ship's structure installed for separation purposes only. The water, settling in the bottom of the tank, is drained overboard by gravity. At about two-thirds depth a pipe connection is made for draining surface oil and sediment to the purifier, which should be fitted in duplicate for emergency and for cleaning during service. From the purifier the reclaimed oil is drained by gravity to an oil tank, the water to the engine room bilge or overboard and the sediment to a storage tank, which may be one of the deep oil tanks. With little attention the water drain valve at the bottom of the tank may be so regulated as to maintain an almost constant level of the mixture in the settling tank near the drain outlet to the separators. Care must be taken to avoid a low level for any lengthy period, which would result in an accumulation of surface oil and the eventual drainage of oily water overboard through the drain valve. In order to prevent overflow on deck through the vent pipe an overflow pipe should be fitted from the top of the settling tank to the pump section. Steam coils in the settling tank will accelerate the separation of oil and water, because oil is reduced more rapidly in specific gravity by the heat than water. Gage glasses should be fitted to indicate the level of the liquid in the tank and its character, especially near the drain connection to the separators. The disposal of the sediment will depend on the circumstances, it may be pumped into a barge or container at the ship's dock, or at the oil companies' docks while taking on fuel oil.

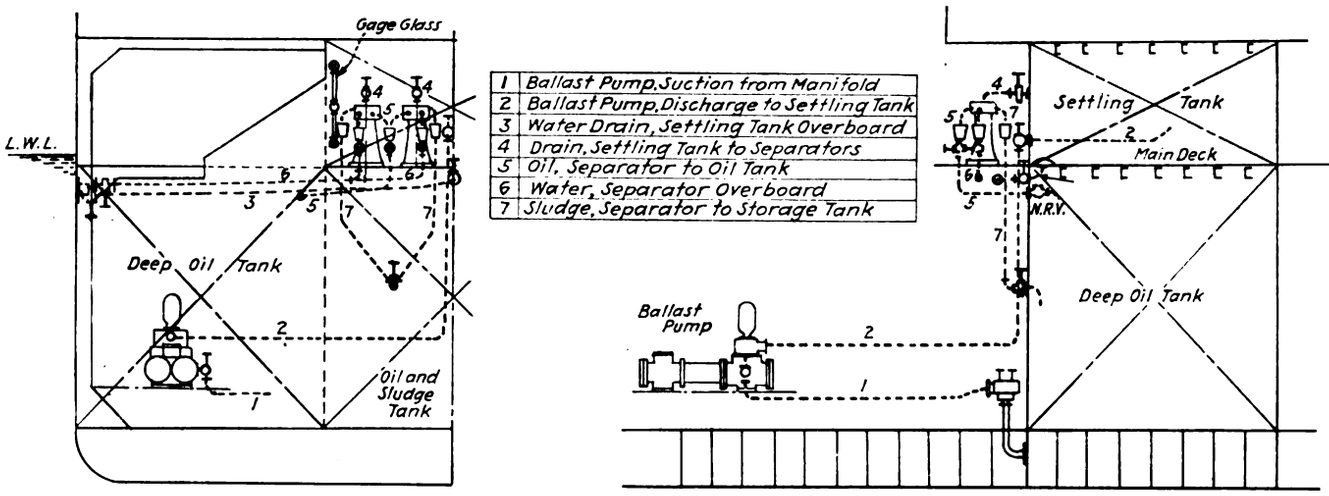

Fig. 6.—Proposed Arrangement for Draining Water from Mixture, Shown Diagrammatically

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GOVERNMENT SHIPBUILING RETURNS.—The Bureau of Navigation, Department of Commerce, Washington, D. C., reports 129 sailing, steam, gas and unrigged vessels of 26,972 gross tons built in the United States and officially numbered during the month of May. This total includes 17 rigged vessels of 785 gross tons and 24 unrigged vessels of 6,968 gross tons, total 41 vessels of 7,753 gross tons built in years previous to 1924.

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Water Rates and Steam Consumption of Auxiliaries*

Definitions and Nomenclature—Steam Used by Auxiliaries Necessary for the Operation of the Propelling Machinery

By E. A. Stevens, Jr.,† and H. E. Brelsford‡

AFTER the steam consumption of the main engine or turbine is determined, that used by the auxiliaries and for other purposes should be obtained, so that an intelligent estimate can be made of the amount of fuel consumed, and the size of boilers, tanks and bunkers required. Unfortunately the quantity of steam used for the above purposes cannot be determined with the same degree of accuracy as that used by the main machinery, but as the amount is considerably less, any error will have much less effect on the total steam consumed than the same percentage error in the estimated steam used by the main engine.

The most accurate method of obtaining the steam consumption is from curves derived from tests, which can often be obtained from the manufacturers of the various machinery. However, great care should be exercised in using such data, for if the conditions during the test are not the same as those under which the machine works in operation, the water rates, as well as the total steam consumed, will probably be quite different, even if the work done or the number of double strokes are the same. For example the water rate of a fire and bilge pump, when taking water from the sea and delivering it to the fire main, will not be the same as when pumping water from the bilge to the sea.

Very often it is impossible to obtain the test data of all the auxiliaries, so in order to make an estimate that would be much better than the guess method generally employed the curves shown in Figs. 1 and 2 have been prepared which will give fairly accurate results when the auxiliaries are operating under average conditions as found on board ships. It will be noticed that the mechanical efficiencies and water rates of reciprocating pumps as shown on these figures vary with the length of the stroke. The accuracy of this may be questioned on the ground that with pumps of the same length of stroke but different cylinder diameters, the water rates would be less and the mechanical efficiency greater for those with the larger diameters, when the work done is in proportion to the size. Although this is true, it would hardly be worth while taking this into account, as the difference is very slight, when compared with the degree of accuracy that is possible to be obtained. It may also be argued that these curves do not differentiate between a simplex and duplex pump and, as the water rate of the former is less than the latter, these curves would not be applicable to one, if they are correct for the other. The answer to this is that the simplex pump would have a longer stroke than a duplex of the same capacity and the difference in water rate is therefore taken care of. When comparing the two types it should be remembered that the duplex corresponds to two simplex pumps each of one-half the required capacity and, if compared, there would be very little difference between the two types, if the dimensions were the same in both cases.

Definitions and Nomenclature

Before going into the method used in estimating the steam consumption of the auxiliaries, it would be well to explain the meaning of various terms.

Head.—The total head on a pump in operation is divided into three different items: First, that due to the suction; second, that due to the pump valves, and third, that due to the discharge resistance. The last two items are always positive while the first may be either positive or negative. For example a fire and bilge pump placed well below the waterline, but above the bilges will have a positive suction head when drawing water from the sea and a negative suction head when pumping from the bilges.

Letting Hs = Suction head
Hv = Head due to the valves
Hd = Discharge head
H = Total head
Then $H = Hd + Hv - (\pm Hs)$

Thus it will be seen that the total head will equal the algebraic sum of the heads.

All of the three heads are made up of two items, first the actual static head in feet (or equivalent head corresponding to the pressure) and the friction head, or in other words the resistance due to friction. The latter can be calculated with some degree of accuracy but such accuracy would hardly be warranted. In order to take care of this resistance, allowances can be made which will be discussed later.

Very often the heads are given in pressures per square inch in place of feet and it is necessary, in such cases, to convert pressures into the equivalent head in feet, so that the necessary power can be figured. In order to readily make this conversion Table I was prepared, which gives not only the head in feet equivalent to a pressure of one pound per square inch, but the weight in pounds per cubic foot and gallons for various substances handled by the different pumps. The weights given for fuel and lubricating oils vary somewhat but, if the figures given are used, the results will be as close as can be desired.

TABLE 1

	Weight in Pounds			Head in Feet Equivalent to a Pressure of 1 Lb. Per Sq. In.
	Per Cubic Foot	Per U. S. Gallon	Per British Gallon	
Fresh water	62.4	8.34	10	2.31
Salt water	64	8.56	10.26	2.25
Fuel oil, 15 deg. Baumé	60.25	8.06	9.66	2.39
Lubricating oil	57.7	7.72	9.26	2.50

Steam Consumption.—The pounds of steam used for a period of one hour is known as the steam consumption.

Water Rate.—Whenever the term water rate is applied to a single unit it refers to the amount of steam used by that unit during a period of one hour divided by the average indicated or shaft horsepower, developed by that unit during this period, except the generators where kilowatts are used in place of horsepower.

When speaking of the water rate of all of the auxiliaries or a certain group of them taken collectively, it refers to the steam used by these for one hour divided by the indicated or shaft horsepower of the main engine (or engines where there are more than one propeller).

Water or Oil Horsepower.—This is the power developed by the water or oil end of the pump and is the power necessary to move a given amount of water or oil in the required time without the losses in the pump. It is equal to the product of the weight of liquid pumped per minute and the total head in feet divided by 33,000.

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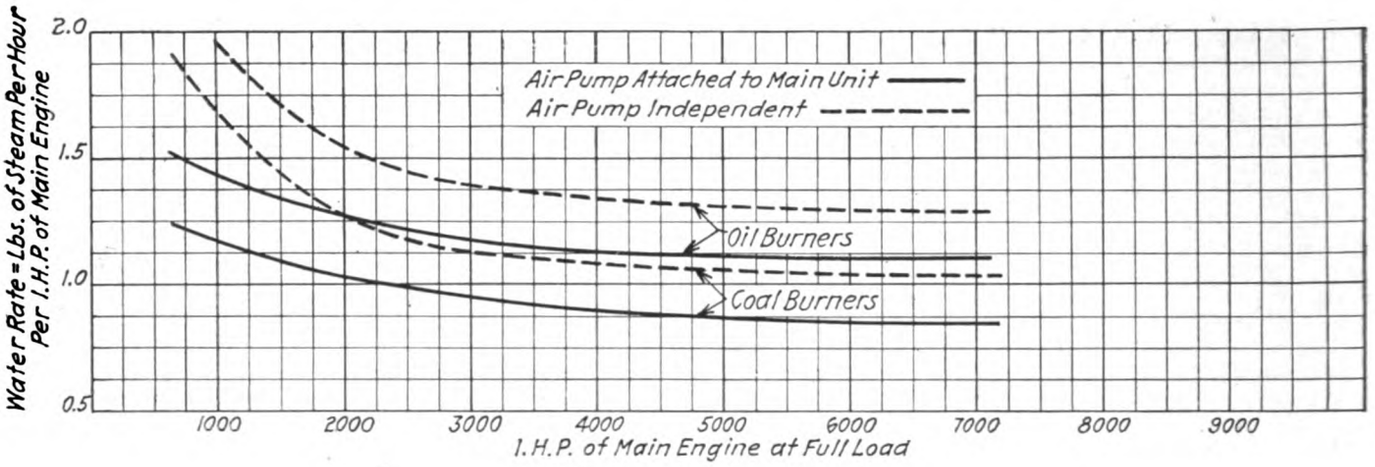

Fig. 1.—Water Rates of Auxiliaries on Ships Fitted with Reciprocating Engines

Auxiliaries: Main feed pumps, fuel oil pumps*, fuel oil transfer pump*, fuel oil heater*, forced draft blower†, main circulating pump†, air pump.

*Not included in coal burners. †Driven by reciprocating engines.

Mechanical Efficiency.—The water or oil horsepower divided by the indicated or shaft horsepower is known as the mechanical efficiency. The efficiency curves given may be considered as approximate only as applied in general as they refer to pumps in good condition that are properly packed and alined and are smooth operating units.

If auxiliaries are of first class quality and workmanship, these efficiencies are easily obtainable.

Grouping of the Auxiliaries

The steam used for purposes other than the main engine or turbine may be divided into three groups, first that consumed by the auxiliaries necessary for the operation of the main engine or turbine and boilers; second, that used by the remaining auxiliaries, and third, the steam used for galley and heating.

First Group.—The auxiliaries included in the first group are as follows:

Main and auxiliary feed pumps.
Forced or induced draft blowers.
*Fuel oil pump.
*Fuel oil heater.
*Fuel oil transfer pump.
Feed water heater.
Main condenser.
Main circulating pump.
†Main air pump.
†Vacuum augmenter, if one is fitted.
Engine and fire room bilge pump.
‡Ash hoisting engine or ash ejector.

If the ship is fitted for forced lubrication the following should be included:

Lubricating oil pump.
Lubricating oil cooling water pump.

If the water for cooling the lubricating oil is taken from another pump (generally the sanitary pump), the last is omitted.

Second group.—The auxiliaries included in this group are the following:

Steering engine.
Dynamo machine.
Ice machine and its auxiliaries, if any.
Sanitary pump.
Fresh water pump.
Drinking water pump.
Evaporators, distiller and their pumps.

The fire and bilge pump and the ballast pump are also included in this group, but as they are used in special cases rather than the general operation of the ship, the steam necessary for their operation should not be included in estimating the general requirements for ordinary operation. The only exception would be on a coal burner fitted with hydraulic ash ejector which requires considerable water for operation and is generally supplied from the fire pump.

If the ship is fitted with a separate condenser to handle the exhaust steam from the dynamo machines, its circulating and air pumps should be included in this group.

The auxiliary condenser and its circulating and air pump is also included in this group, but as this equipment is not used while underway its steam consumption is only of interest when considering port performances.

Auxiliaries of the First Group

The steam used by most of the auxiliaries of the first group will depend more or less upon the total steam generated by the boilers or condensed in the condenser. The steam used by the feed pump will depend, to a considerable extent, upon the amount of feed water pumped to the boilers while that used by the main circulating pump, air pump and vacuum augmenter, if one is fitted (or the air ejector and condensate pump, if there is no air pump or air pump and augmenter), will depend largely upon the weight of steam condensed in the condenser. The steam used by the blower engine will be governed more or less by the amount of air delivered to the furnaces. If the ship is fitted to burn oil, the steam used by the fuel oil pump, fuel oil heater and the fuel oil transfer pump, together with the air delivered to the furnaces, will depend upon the amount of fuel burned, which in turn varies with the water evaporated, providing the boiler efficiency remains constant.

Considering the above, one can readily see that the steam consumption or water rate of this group can be based, with considerable accuracy, upon the power developed by the main unit. With this in view the curves shown in Figs. 1 and 2 have been prepared which will, in most cases, give very close results, if the auxiliaries measure up to the standard of good workmanship and material and are of proper proportion, also if they are of the type as marked on these figures and properly operated. If the forced draft blower and main circulating pump or either one of them be driven by a turbine in place of a reciprocating engine, the water rates will be slightly higher (the difference being greater for the smaller powers). If the blower or any other auxiliary of this group is driven by an electric motor, or natural draft is used, the water rate of this group will be less, in which case, if a more accurate estimate is desired, the steam consumption of each unit should

*These auxiliaries are only on ships using oil for fuel.
†The main air pump and vacuum augmenter are sometimes replaced with an air ejector and condensate pump.
‡For coal burners only.

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be calculated independently, which method will be described later.

If it is desired to make allowances for the increased amount of steam used due to using turbines for driving the blowers or circulating pump without making individual calculations for all of the auxiliaries of this group, estimate the steam used by the auxiliary if driven by a turbine and by a reciprocating engine and add the difference to the consumption as obtained by multiplying the given water rate by the indicated or shaft horsepower. If the blower is operated by an electric motor, or if natural draft is used, calculate the steam used by a blower operated by a reciprocating engine and subtract same from the steam consumption found by the product of the water rate (from Figs. 1 or 2) and the indicated or shaft horsepower of the main unit or units.

It will be noticed that the steam used by the engine and fire room bilge pumps and the lubricating oil cooling water pump is not included in the curves on Figs. 1 and 2, as in many cases the water in the engine and fire room bilges is handled by a pump worked from the main engine, and in most cases the circulating water for the lubricating oil coolers is supplied by one of the other pumps. If, however, the engine and fire room bilge pumps are independent of the main unit, and a separate pump is used for supplying the water to the oil coolers, calculations can readily be made, as will be shown later.

If the ship is fitted with more than one propeller, the following rules should be followed for obtaining the water rates of the auxiliaries of the first group from Figs. 1 and 2:

Twin, triple or quadruple screw ships fitted with either reciprocating engines or turbines, where each shaft is independent of the others: use the power developed on one shaft.

Twin screw ships fitted with a high pressure turbine on one shaft and a low pressure turbine on the other: use the power of both shafts.

Triple screw ships fitted with a high pressure turbine on the center shaft and a low pressure turbine on each wing shaft: use one-half of the total power.

Quadruple screw ships fitted with two high and two low pressure turbines or with a high, intermediate and two low pressure turbines: use one-half of the total power.

The steam consumed per hour will, in all cases, be the product of the water rate thus obtained and the total indicated or shaft horsepower of all of the shafts.

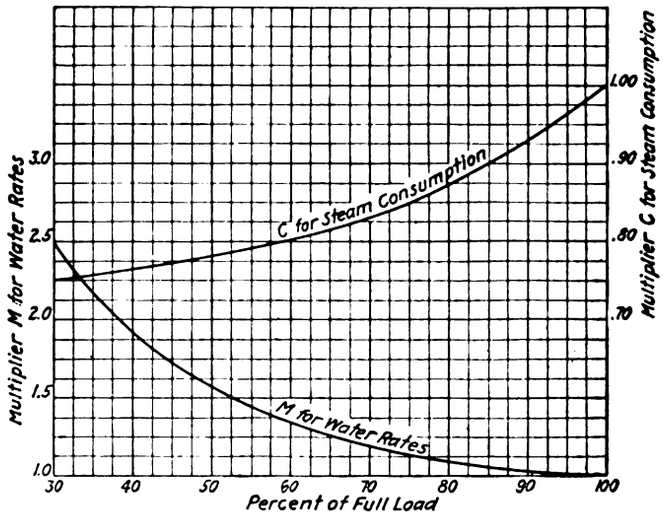

Fig. 3.—Corrections for Reduced Loads

Water rate of auxiliaries of the first group at reduced loads = water rate at full load × M; steam consumption = steam consumption at full load × C.

EXAMPLE NO. 1

Given a twin screw ship with reciprocating engines. Total indicated horsepower, 6,000. The engine room bilge pump and the main air pump being driven by the main engines, the other auxiliaries are as mentioned on Fig. 1. Find the water rate and steam consumption of the auxiliaries (a) for coal burners and (b) for oil burners.

The power of one shaft is 3,000 indicated horsepower.

(a) From Fig. 1 we find that the water rate for a 3,000 indicated horsepower unit, using coal as fuel, is 0.95. Then the steam consumption is 6,000 × 0.95 = 5,700 pounds per hour.

(b) From the same figure we find that the water rate, when oil is used as fuel, is 1.17. Then the steam consumption is 6,000 × 1.17 = 7,020 pounds per hour.

If the air pumps were independent, the water rates would have been 1.12 for coal burners and 1.4 for oil burners and the steam consumption would be as follows:

For coal burners, 6,000 × 1.12 = 6,720 pounds per hour.

For oil burners, 15,000 × 1.61 = 24,150 pounds per hour.

If the engine room bilge pumps are independent of the main unit, the steam used by these units should be calculated (as shown later) and added.

EXAMPLE NO. 2

Given a triple screw ship fitted with geared turbines, one high and one low pressure turbine driving each shaft through gears (each shaft independent of the other). Total shaft horsepower, 15,000. Find the water rate and steam consumption of the auxiliaries of the first group (a) when coal is used as fuel and (b) when oil is used as fuel.

The power of one shaft is 5,000 shaft horsepower.

From Fig. 2 we find the water rate is 1.29, when coal is used as fuel, and 1.61, when oil is used as fuel.

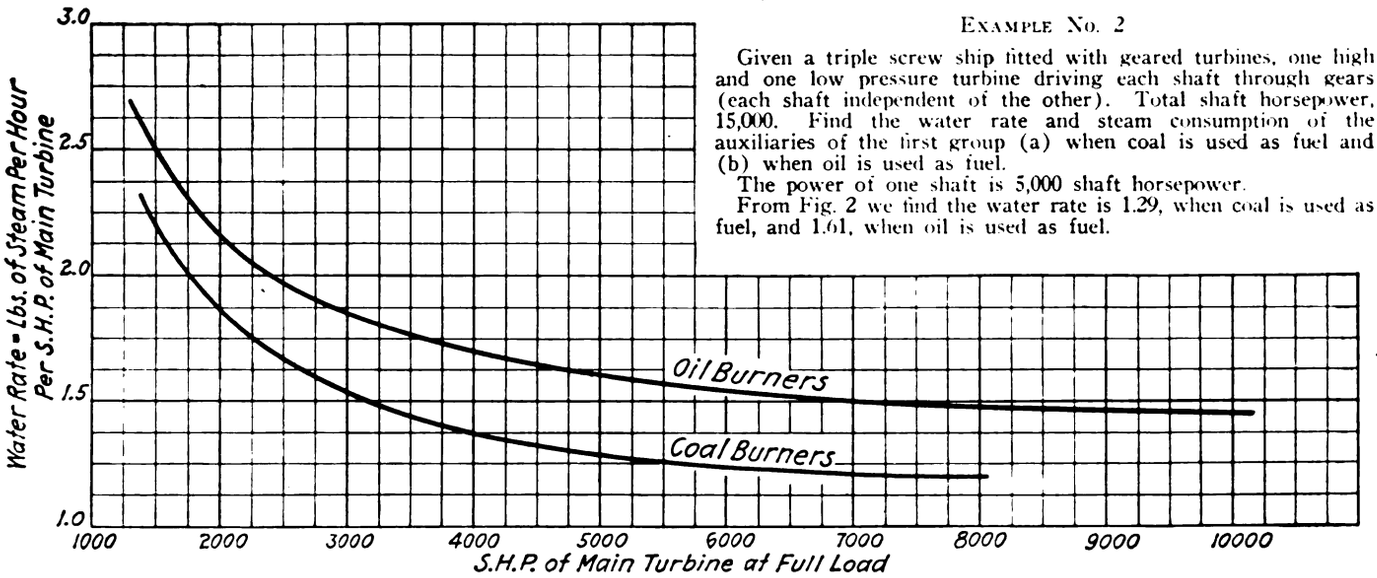

Fig. 2.—Water Rates of Auxiliaries on Ships Fitted with Geared Turbines

Auxiliaries: Main feed pump, fuel oil pump*, fuel oil transfer pump*, fuel oil heater*, forced draft blower†, air ejector or vacuum augmenter, condensate pump or air pump, main circulating pump†, lubricating oil pump.

*Not included in coal burners. †Driven by reciprocating engines.

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The steam consumption will then be as follows:

For coal burners, 15,000 × 1.29 = 19,350 pounds per hour.

For oil burners, 15,000 × 1.61 = 24,150 pounds per hour.

To this should be added the steam consumed by the engine and fire room bilge pumps and the oil cooler pump, if one is fitted and operated.

WATER RATES OF GROUP 1 AT REDUCED LOADS

Figs. 1 and 2 give the water rates at full load only and, as it is often desirable to obtain water rates and steam consumption at reduced loads, Fig. 3 has been prepared, which gives the ratio of the water rate and steam consumption at fractional loads to those at full load. In order to illustrate the use of this figure the following examples are given:

EXAMPLE NO. 3

Given a single screw cargo vessel with a reciprocating engine of 3,000 indicated horsepower with air and engine room bilge pump attached to main engine, coal being used as fuel. Find the water rate and steam consumption of the auxiliaries of the first group when operating at full power and at 2,500 indicated horsepower.

Percentage of full load $= \frac{2{,}500}{3{,}000} \times 100 = 83.3$ percent. Water rate at full load from Fig. 1 = 1.18 pounds. Steam consumption of full load = 3,000 × 1.18 = 3,540 pounds per hour. From Fig. 3 we find that the water rate at 83.3 percent of full power is seven percent higher than at full load, therefore water rate at 2,500 indicated horsepower equals 1.18 × 1.07 = 1.262 pounds and the steam consumption equals 2,500 × 1.262 = 3,150 pounds. After obtaining the steam consumption at full load, that for 2,500 indicated horsepower or 83 percent of full load can be obtained directly as follows:

Steam consumption at full load = 3,540 pounds per hour.

Correction factor C from Fig. 3 for 83.3 percent of full load = 0.889.

Steam consumption at 2,500 indicated horsepower = 3,540 × 0.889 = 3,150 pounds per hour.

EXAMPLE NO. 4

Given a twin screw passenger ship with reciprocating engines of 10,000 indicated horsepower (total), with air and bilge pumps independent of main engine, using oil for fuel. Find the water rate and steam consumption of the auxiliaries of the first group when the main engines are operating at 7,000 indicated horsepower.

Percent of full power, $= \frac{7{,}000}{10{,}000} \times 100 = 70$ percent.

Water rate of a 5,000 indicated horsepower outfit or of one unit a full load from Fig. 1 = 1.31. From Fig. 3 we find the multiplier M for 70 percent of full load to be equal to 1.19. Then the water rate at 70 percent full load (or 7,000 indicated horsepower on both shafts) equals 1.31 × 1.19 = 1.56 pounds and the steam consumption will be 7,000 × 1.56 = 10,910 pounds.

The steam consumption of the bilge pump (the calculations of which will be shown later) is 1,075 pounds per hour, making the total water consumption = 10,910 + 1,075 = 11,985 pounds per hour.

The steam consumption at 70 percent of full load may also be found as follows:

Steam consumption at full load = 10,000 × 1.31 = 13,100 pounds per hour.

Correction factor C, for 70 percent of full load, from Fig. 3 = 0.831.

Steam consumption at 7,000 indicated horsepower = 13,100 × 0.831 = 10,890 pounds per hour.

The steam consumed by the engine room bilge pump (1,075 pounds) should be added, making 11,965 pounds per hour.

The steam consumed by the engine room bilge pump can be added to the steam consumption at full load and then apply the correction fractor C, with very little difference in the results.

Steam consumption at full load including bilge pump = 13,100 + 1,075 = 14,175 pounds.

Correction factor C for 70 percent of full load, from Fig. 3 = 0.831.

Steam consumption at 7,000 indicated horsepower = 14,175 × 0.831 = 11,780 pounds.

The difference between the two methods of handling the steam used by the bilge pump is less than 2 percent of the steam used by the auxiliaries of the first group or about ¼ percent of the total steam consumed for all purposes.

For turbine ships the calculations are made in the same manner except that Fig. 2 is used in place of Fig. 1.

(*To be continued*)

Impulse Turbine Designed to Operate Under High Pressure and Superheat

IN developing the new line of velocity stage turbines, shown in the accompanying illustrations, the De Laval Steam Turbine Company, Trenton, N. J., took into account the new requirements of high steam pressure and superheat available for operating auxiliary equipment. Suitable materials to withstand high temperatures have been used in the construction and parts have been arranged so that bearings are not exposed, the expansion thus being cut down and misalinement avoided.

The casing, as may be seen in Fig. 2, is intended to be supported on a single pedestal at a point close to its center line. The use of a single support diminishes the liability to distortion troubles, as the turbine can expand freely in all directions without affecting the alinement of the shaft. The

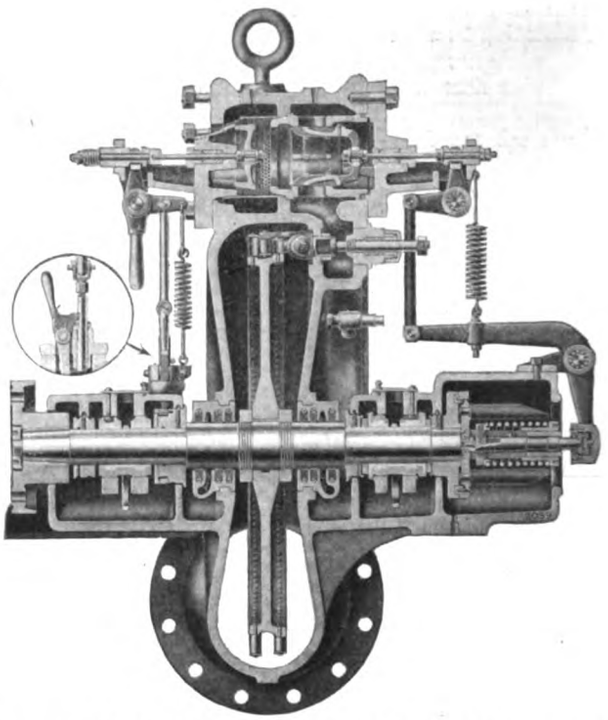

Fig. 1.—Axial Section of De Laval Velocity Stage Turbine

turbine shaft is supported in two bearings, one at either side of the housing and is connected to the shaft of the driven machine by a flexible coupling.

The steam inlet nozzle, steam chest and governor valves are all included in the upper half of the casing, thus shortening the steam passages and reducing radiating surface and also keeping high temperature steam away from bearings, bearing oil reservoirs and bearing supports. Water cooling is not required. The governor valve casing, steam chest and the upper half of the turbine casing are cast integral and are made of steel for high pressure and high temperature steam. There are no cross-over steam connections.

The speed governor weights are pivoted on knife edges supported in seatings carried by a governor flange or body, which is keyed and set screwed to the turbine shaft. When the weights spread apart under the influence of centrifugal force, the motion is transmitted to a pin, which, through a ball thrust bearing, acts upon a bell crank connected by a link to a second bell crank engaging the spindle of the regulating valve. A spring attached to the first bell crank takes up any slack in the mechanism and also provides supplementary means for regulating the speed.

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The emergency trip or overspeed governor is entirely separate and independent from the speed governor and is located on the opposite side of the wheel. An unbalanced ring is hinged on a pin attached to a flange set-screwed to the turbine shaft and is held concentric by a small spring. When a speed 10 to 15 percent higher than the normal speed is exceeded, the unbalanced force of this ring compresses the spring so that the ring strikes against a trip lever, the upper end of which normally acts as a support to hold a notched rod. As soon as the lever is struck by the emergency trip weight or is pulled out manually, for which purpose a handle is provided, a spring draws the rod down and the latter,

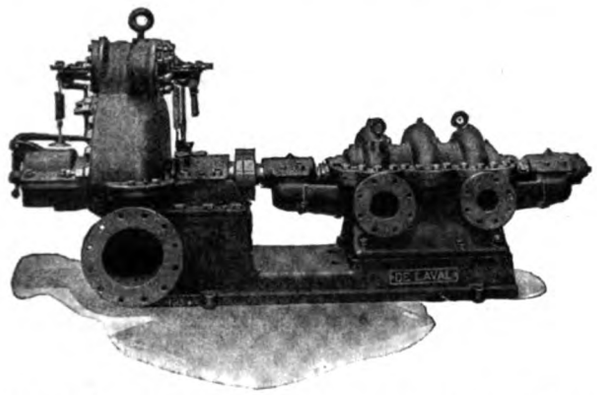

Fig. 2.—De Laval Turbine Driving Centrifugal Pump

through the medium of a bell crank, closes the emergency valve.

To reset the emergency valve, it is drawn back by means of a handle on the bell crank before mentioned until the trip lever can again engage the notch in the rod. When set, the valve is pulled all the way back so that a collar on the monel metal stem seats against the valve cover and prevents leakage of steam, thus relieving the stuffing box.

The steam inlet nozzle is alongside the emergency governor valve, and the turbine is protected by a monel metal strainer located in the governor valve body.

The wall of the steam chest adjacent to the turbine wheel chamber supports the nozzles through which the steam is

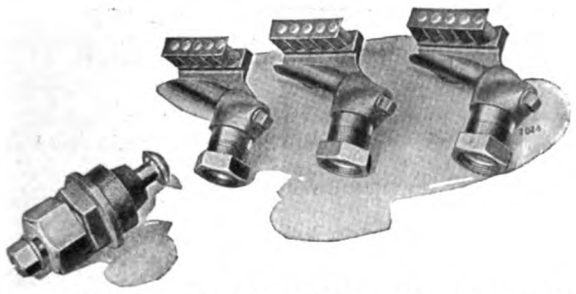

Fig. 3.—Nozzles with Attached Interstage Guide Vanes

directed against the wheel buckets. A complete nozzle, with fastening nut and interstage guide vanes, is illustrated in Fig. 3. The guide vanes are securely riveted to an extension of the nozzle casting, and the inner ends of the vanes are also supported by a riveted shroud. As the turbine is of the pure impulse type, the steam is completely expanded to exhaust pressure upon leaving the nozzles and close clearances between nozzles, wheel buckets and guide vanes are unnecessary, either axially or radially.

Where considerable changes in load or in steam pressure are anticipated, some of the nozzles can be provided with hand operated valves and by cutting nozzles in or out it is possible to maintain a high average pressure in the steam chest, with correspondingly high efficiency over a wide range of capacity.

The wheel has two rows of buckets, as shown in Fig. 4. The shanks of the nickel steel buckets pass through radial holes bored in the overhanging rim of the wheel and are riveted over on the inside of the latter. Shroud strips riveted on the outer ends of the buckets provide rigidity and prevent spilling of steam. Sufficient space is left between the ends of

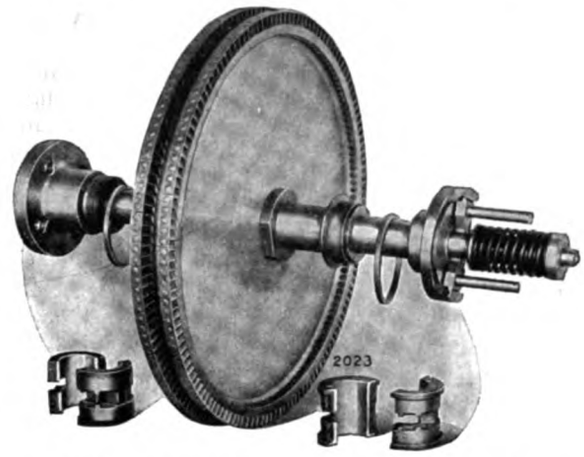

Fig. 4.—Wheel, Shaft and Governor of Turbine

the shroud strips to provide for expansion due to high temperature.

The turbine wheel is a high grade steel forging provided with an ample hub. The wheel is mounted on a heavy, rigid forged steel shaft and is held in position on the shaft by two heavy locking nuts. The stuffing boxes where the shaft passes through the walls of the housing are each fitted with three carbon packing rings, a space cored out between the outside and middle rings providing for steam sealing when operating under vacuum.

All parts entering into the construction of the turbine are made to limit gages to insure absolute interchangeability of parts. The line of velocity stage turbines described in this article is built in sizes from 1 to 1,000 horsepower.

Contracts in June Exceed $10,000,000

VESSEL construction and repair contracts totaling $10,119,675 have been awarded American shipyards in various parts of the country during the month of June. The outstanding feature of the month was the placing of the contract for a new combination passenger and freight ship for the Matson Line with the William Cramp and Sons Ship & Engine Building Company to cost $4,792,000. Second to this in attraction was the announcement of the virtual turning over of a contract for a $2,250,000 steamer for the New York and Porto Rico Line to the Newport News Shipbuilding & Drydock Company.

Other noteworthy awards for the current month include six New York City ferries, three each to be built by the Tebo Yacht and Basin Company of the Todd Shipyards Corporation, and the Staten Island Shipbuilding Company, at a total cost of $1,490,040; extensive repair contracts on Shipping Board vessels totaling $692,395; construction of patrol boats by the Moore Shipyard at $328,320; announcement of the conversion of the *Mary Weens* by the Sun Shipbuilding Company at $323,000; construction of patrol boats by A. W. de Young at $221,670; and repairs to the *West Selene* by the Federal yard $22,250, making a total of $10,119,675 for the contracts enumerated.

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The Resistance of Low and Average Speed Ships*

Application of Standard Series Experiments to Present Day Cargo Vessels—Diagrams for Calculating Residual Resistances

By J. C. Abenbout Schokker

WHILE the models of merchant ships have been the subject of a large amount of experimental investigation, notably by Sadler, Taylor, Baker and Kent, the data acquired previous to 1916-17 are, in large part, of an approximate character when applied to present-day conditions.

This is principally due to the fact that within the past ten years beam has increased more rapidly than length. For example, Sadler's models had a length-breadth ratio of 8, while large cargo vessels today have ratios of 7 to 7.5 and small ones even as low as 6, and it is possible that beams may be still further increased in the future.

The applicability of a set of standard resistance curves to a particular case is indicated by the value of Taylor's "C" factor

$$C = \frac{\text{Displacement}}{(0.01\ \text{Length})^3}$$

An investigation of 83 existing merchant vessels shows C to be above 300 for the smallest vessels (less than 130 feet long) and that it decreases with increased size, being between 160 and 180 for ships between 450 and 500 feet in length. As speed increases, the value of C decreases for ships of the same length; for 15-knot, 500-foot mail steamers, it lies, approximately, between 120 and 140.

In Taylor's standard series, the highest value of C is around 180, so it is evident that this series is not, in general, applicable to merchant vessels, as only the very largest modern vessels, come within its range. Furthermore, the models used had no parallel middle body and finer midship sections than are customary in merchant vessels.

Kent's series, published in 1919, better meets present-day requirements. Four groups of models were tested, having cylindrical coefficients of 0.665, 0.689, 0.758 and 0.827 respectively. Three series were carried out with each group. In the first, length and draft were constant, while beam was altered; in the second, the ratio of beam to draft was kept constant, thus resulting in a variation of C with no modification of any other factor except slight changes in cylindrical coefficient which can be neglected; while in the third series, beam and draft were so altered that the midship section area remained constant.

Increasing the beam reduces the beam-draft ratio, so that the effect of this factor may be studied in the results of the third series, but there are, unfortunately, changes in the cylindrical coefficient which interfere with the comparison of the results obtained.

The first requirement in systematic model experiments is that while one factor is being varied, all others should remain constant. In Kent's experiments, this does not seem to have been done, and in order to investigate the influence of C in any particular case, the effect of cylindrical coefficient changes must first be estimated by interpolating the results of the four model groups, and it may often happen that a vessel lies between two groups.

In order to eliminate the tedious process of interpolation, Kent's second series (influence of C) has been recast into diagrams from which the resistance at each value of C and cylindrical coefficient can be read off.

*Abstract of a translation made by E. V. Telfer, A. M. I. N. A., of a paper published in *Het Ship* February 22, 1924.

Kent's work gives total resistances, both frictional and residuary, and is thus not independent of the absolute size of ship. The Taylor presentation of residuary resistance, expressed in pounds per ton of displacement, gives results which are independent of size and, consequently, of greater availability for general use.

In order to present the results of the Kent series, in the Taylor form, the frictional resistance of each model was calculated, using Mumford's formula for wetted surface and Froude's coefficient for surface friction. This was deducted from the total resistance, given by Kent's experiments, and the remainder, or residuary resistance, expressed in pounds per ton of displacement, was plotted, for each model, on a base of speed-length ratio, or $\frac{V}{\sqrt{L}}$. From the resulting curves, values of pounds per ton for speed-length ratios, increasing by 0.05, from 0.50 to 0.75 were read off. For each value of $\frac{V}{\sqrt{L}}$, two curves can be constructed, one, on a basis of C, which connects up the results obtained from the models of one definite group, and a second, on a basis of cylindrical coefficient, which was obtained by combining the results for models of the same dimensions, taken from the various groups. From these curves, the particular combinations of C and cylindrical coefficient corresponding to definite values of pounds per ton can be read off and thus the curves of constant values of residual resistance in pounds per ton, which accompany the present article, were constructed.

While the diagrams are constructed in the same manner as Taylor's they extend to much higher C and cylindrical coefficient values. On the other hand, they do not cover the lower values of C which, however, are of little importance in slow speed vessels.

In constructing the diagrams, it is not always possible to draw fair curves through the points obtained. As the speed increases, the spots are distributed over a definite range, of which the lines drawn represent the mean. The fact that the curves must never intersect is of assistance in drawing them. Intersection would indicate two different resistances at the same speed. For $\frac{V}{\sqrt{L}} = 0.75$ the points over a considerable

TABLE I

Cylindrical Coeff.	$\frac{V}{\sqrt{L}}$	$\frac{R_1}{R_2}$	$\frac{R_3}{R_2}$
0.689	0.50	0.55	1.39
0.689	0.61	0.66	1.34
0.689	0.72	0.71	1.96
0.758	0.50	0.65	1.46
0.758	0.61	0.71	1.36
0.827	0.50	0.81	1.84
0.827	0.61	0.70	1.24

These values refer to a value of $\frac{\Delta}{(0.01L)^3} = 183.$

R_1 = residuary resistance for beam-draft ratio 1.81.
R_2 = residuary resistance for beam-draft ratio 2.81.
R_3 = residuary resistance for beam-draft ratio 4.03.

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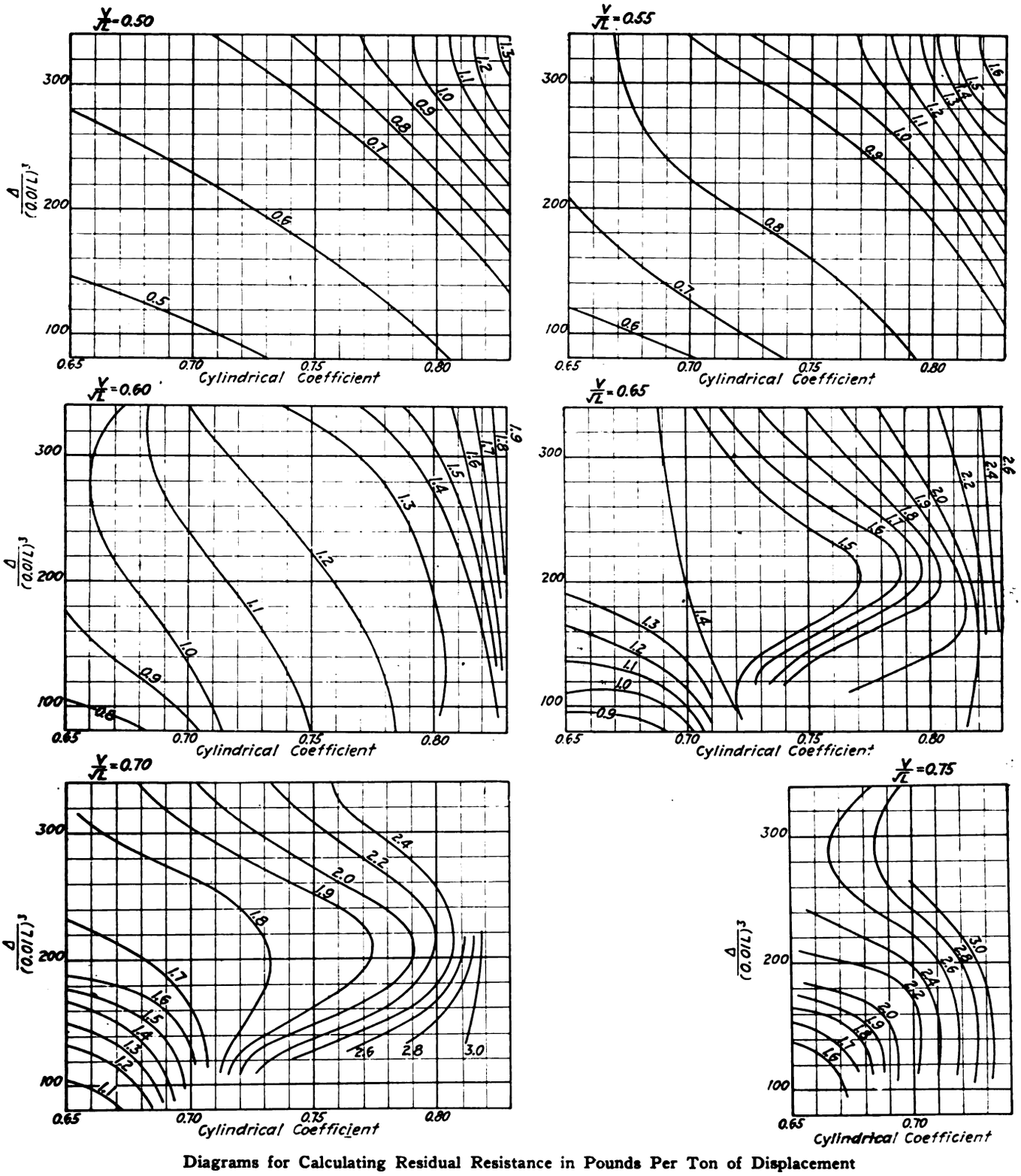

Diagrams for Calculating Residual Resistance in Pounds Per Ton of Displacement

Based upon Kent's experiments (T. I. N. A. 1919). Froude's coefficients used for calculating frictional resistance (see Baker's "Ship Form, etc.," page 21).

portion of the diagram were too irregular to enable curves to be drawn through them: this portion has consequently been omitted.

It will be noted that a zone exists in the middle of each diagram in which considerable change in C or the cylindrical coefficient may take place without materially changing the resistance.

Unfortunately, the particular group of models considered has a beam-draft ratio of 2.80, much higher than current practice, which rarely exceeds 2.50 and it is necessary to consider what the effect of this may be. Kent's final series contains a few models having an approximately constant value of C = 1.83 and beam-draft ratios of 1.81, 2.81 and 4.03. Thus we may interpolate between the first two to meet our needs. To determine the influence of this factor a comparison was made for a few cylindrical coefficients at two speeds by calculating the residuary resistance for each of three beam-draft ratios. These results are given in the

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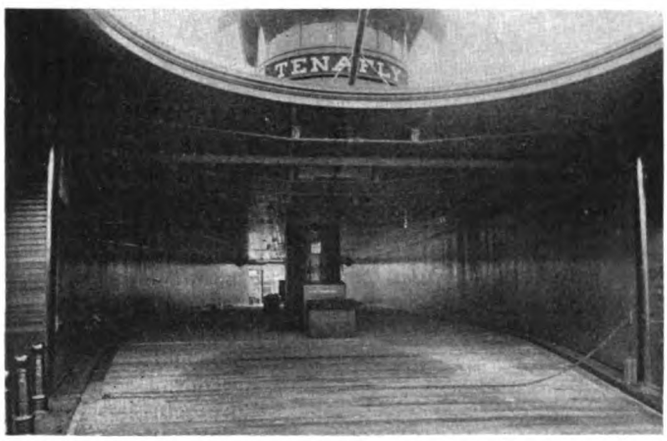
table accompanying the diagrams and indicate that no general conclusion can be drawn.

The diagrams hold good for models having a midship section area coefficient of 0.98 and a beam-draft ratio of 2.80. The influence of different beam-draft ratios may be estimated from the table on page 432.

In conclusion, it should be mentioned that Kent's models all had full midship sections; the midship section area coefficient for the intermediate draft being 0.98. Although slight variations from this, say to 0.96 or 0.99, have no appreciable influence on the results, the diagrams should not be used for midship section coefficients differing materially from the standard adopted.

Automobile Capacity of Ferryboats Doubled

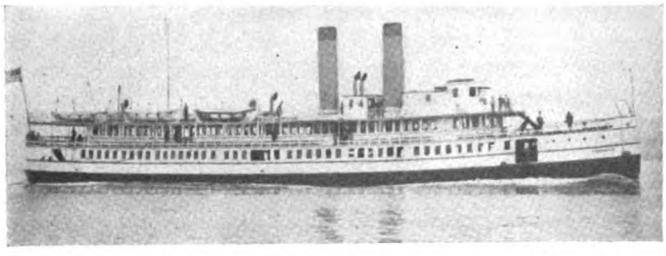
THE heavy increase in automobile traffic over the Hudson river as well as in Puget Sound in the past few years has resulted in the ferry companies increasing the capacity of their boats. In many instances the accommodations for automobiles has been doubled without seriously decreasing the cabin space for passengers.



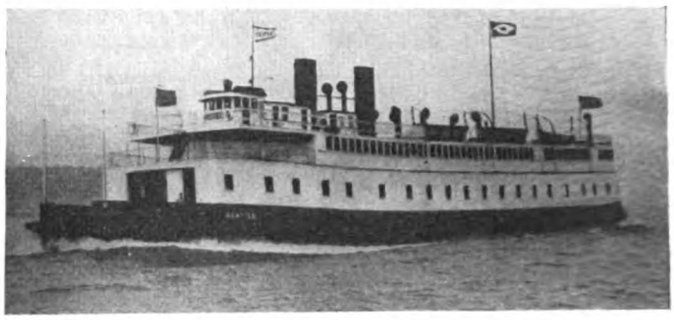
Fort Lee Ferry Tenafly, Showing Increased Accommodations for Automobiles

A large part of this work has been carried out at the Hoboken and Seattle plants of the Todd Shipyards Corporation. Two of the last ferries recently in the Hoboken yard were the *Tenafly* and the *Hackensack*. These boats were throughly overhauled and rebuilt. They are in service between Fort Lee and 129th Street, New York, where automobile traffic is extremely heavy.

The longitudinal in-board cabin bulkhead has been moved out approximately 7 feet 3 inches on both sides and the new gangway thus formed decked and sheathed. This additional space allows twice as many automobiles to be carried, a total of 52 cars, which if placed end to end would reach nearly half a mile. The seating capacity in the passenger cabins remains the same, though the thwartship seats were replaced by longitudinal benches.



S. S. H. B. Kennedy Before Conversion to an Automobile Ferry



Passenger and Automobile Ferry Seattle, Formerly S. S. H. B. Kennedy

The upper house enclosure was entirely removed and the smokestacks, ventilators and uptakes cut down and altered to fit the new requirements. The propelling machinery, auxiliaries and pumps on both vessels were tested and new parts installed where necessary. The old steering engines were removed and replaced by new machines in compartments built below their former location.

The lengthening and widening, which practically amounted to rebuilding, of two ferry steamers to take care of the automobile traffic on Puget Sound has been completed at Seattle by Todd Dry Docks, Inc., and work is now in progress on a third for the run between Victoria and Port Angeles across the strait of Juan de Tuca.

The *Seattle,* which was formerly the *H. B. Kennedy,* had a very successful trial trip and although she has been sponsoned out 8 feet on each side she made practically the same time on her run from Seattle to Bremerton. This vessel now is able to handle more than fifty automobiles on each trip.

The ferryboat fleet of the New York Central Railroad is also being converted from coal to oil burning at the Tietjen & Lang Dry Dock Company. Three boats have already been completed, leaving five yet to be changed over. Twenty-two of the New York Central's tugboats and lighters were converted to oil burning by the installation of Todd burners at this plant.

Syndicate Clauses Altered

A NEW policy has been issued by the American Marine Insurance Syndicates in which three of the former clauses have been slightly altered. They now read as follows:

Returns Clause. In the event of the vessel being laid up in port for a period of 30 consecutive days, a part only of which attaches to this policy, it is hereby agreed that the laying up period, in which either the commencing or ending date of this policy falls, shall be deemed to run from the first day on which the vessel is laid up and that on this basis underwriters shall pay such proportion of the return due in respect of a full period of 30 days as the number of days attaching hereto bear to thirty.

Adventures and Perils Clause. Touching the Adventures and Perils which we, the said Assurers, are content to bear and take upon us, they are of the Seas, Men-of-War, Fire, Enemies, Pirates, Rovers, Thieves, Jettison, Letters of Mart and Counter-Mart, Surprisals, Takings at Sea, Arrests, Restraints and Detainments of all Kings, Princes and Peoples, of what nation, condition or quality soever, Barratry of the Master and Mariners, and of all other like Perils, Losses and Misfortunes that have or shall come to the Hurt, Detriment or Damage of the said Ship, &c., or any part thereof.

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Latent Defect and Negligence (Inchmaree) Clause. This Insurance also specially to cover (subject to the free of average warranty) loss of, or damage to hull or machinery, through the negligence of Master, Charterers, Mariners, Engineers or Pilots, or through riots, explosions (whether on board or ashore), bursting of boilers, breakage of shafts, or through any latent defect in the machinery or hull, provided such loss or damage has not resulted from want of due diligence by the Owners of the Vessel, or any of them, or by the Manager, Masters, Mates, Engineers, Pilots or Crew not to be considered as part owners within the meaning of this clause should they hold shares in the Vessel.

Air Propeller Driven Boats Beat Express Trains*

A NEW type of water craft drawing practically no water is being developed in Paris for service on tropical streams in the French colonies hitherto unnavigable on account of shallowness, shifting sandbars or underwater vegetation. A boat that floats in six inches of water has also been announced from Lahore, India, where it is in daily use.

Hydroglissia is the name given to flat-bottom boats driven over the surface of the water by an aeroplane engine and propeller. In various races held at Monaco and on the Seine near Paris, the speed of express trains has been consistently equalled. The world's record is held by M. Besson whose hydroglissia officially made 74 miles an hour. His unofficial record for a later trial is 95 miles an hour.

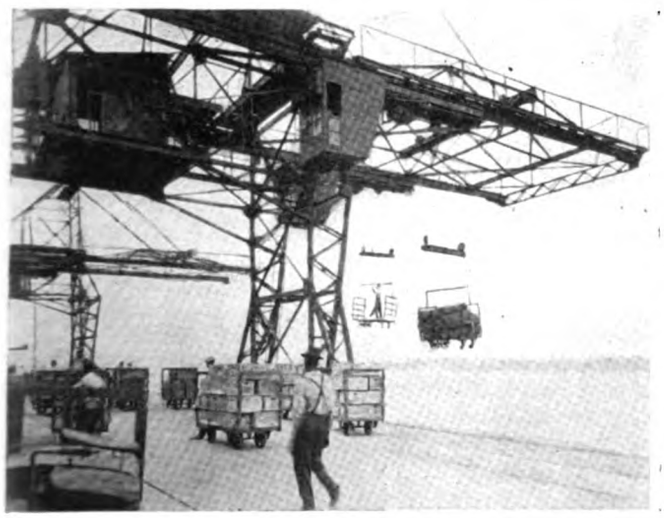
The hydroglissia on the Sutlej river, India, is used for communication purposes. Its flat-bottom construction enables it to pass over sand-banks only a few inches submerged. In motion it rises to the surface. The keel of the boat is divided into two halves by a step of nine inches, this being an improvement on the French designs.

When the 90 horsepower engine is started, the boat moves forward, the pressure of the water under its bow causing the first "step" to rise to the surface. The water then swirls under the nine-inch step and another wave is created lifting the stern. As the speed is increased the boat rises increasingly out of the water.

It is said that a speed of 35 miles an hour has been obtained with this craft carrying seven persons. The advantage of these boats in India is that at a high speed they can pass over submerged sandbanks which have always been found most difficult to locate by navigators of Indian rivers.

Hydroglissias are being prepared for service in French Africa and Indo-China. One type already built carries 20 tons of freight. Another type with two aeroplane propellers and two motors can run steadily at 45 to 50 miles an hour with a load.

*Science service correspondence.



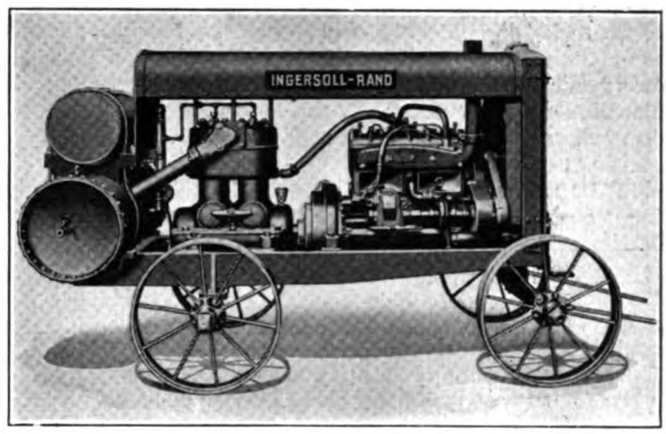
(Photograph by Keystone View Co., Inc., N. Y.)

Labor Saving Electric Cranes on Uncle Sam's Dock at St. Louis

The government has taken hold of the river transportation problem and it is now possible to move freight from Chicago to New Orleans in seven days —a faster gait than by the railroads and at a 20 percent lower tariff Tows from the steel mills along the Ohio and Alleghany are transferred to the Mississippi and along the gulf. Even print paper for the Chicago newspapers is coming from Norway to New Orleans and thence up the river.

Small Portable Air Compressor

A SMALL portable air compressor plant of modern design and construction, has been developed and is now being offered by the Ingersoll-Rand Company, 11 Broadway, New York. This small portable air compressor, designated as the 4¼-inch by 4-inch type "Twenty," has a piston displacement of 60 cubic feet per minute and is built along the same lines as the larger type "Twenty" portables.



New Portable Air Compressor

All of the proven features of the larger units are retained, e. g., duplex, vertical compressor, direct-connected to a four-cylinder, four-cycle, tractor type gasoline engine; enclosed construction; circulating water cooling system for engine and compressor with sectionalized-radiator, fan, and pump; compressor regulator and engine control for reducing speed during unloaded periods; one-piece cast steel frame; sheet steel roof and removable side doors.

This compressor can be furnished with a variety of mountings; steel wheels and axles; wooden artillery wheels with solid rubber tires and steel axles; on a Ford truck; and on skids for mounting in a car or truck. This and other sizes of type "Twenty" portable compressors are available with either gasoline engine or electric motor drive.

There are four larger Ingersoll-Rand portable compressors having the following piston displacements: 91, 160, 210 and 250 cubic feet free air per minute.

NEW GREAT LAKES FREIGHTERS.—Three more 600-foot bulk freighters will be placed in commission on the Great Lakes this season. The 600-foot freighter being built for the Franklin Steamship Company at the River Rouge yards of the Great Lakes Engineering Works, will be launched about the middle of July and be delivered late in September. The two steamers of the same class building for the Ford Motor Company will be put into commission during July.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Margin for Bolt Holes in Heavy Castings

Q. (1,250).—How is the distance "x" (Fig. 1) mathematically obtained so that it will have the strength equivalent to that of the bolt, both in the direction F_H and F_V? Of course, I understand that there is also in addition a bending moment with force F_V, and the classification society has rules for plate laps. What I have in mind is the margin required for holes in heavy castings, etc.

A. (1,250).—The writer is unable to answer this question satisfactorily at the present time. Information bearing upon the subject may be found in "Elements of Machine Design," Part I, by Unwin under the subject "Strength of Riveted Joints" and in "Structural Design of Warship" by Hovgaard under the heading "Strength of Riveted Joints, Modes of Fracture." However, it is believed to be the practice to fix the value of "x" by reference to the plans of machinery which has operated successfully and which is similar to that in question. Study of a large number of such plans shows that the distance from the center of the bolt hole to the edge of the plate or casting averages about 1.5 times the diameter of the bolt.

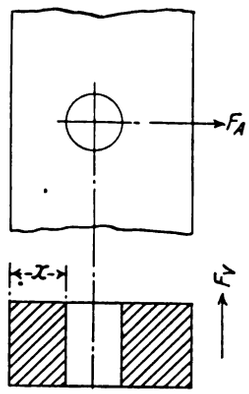


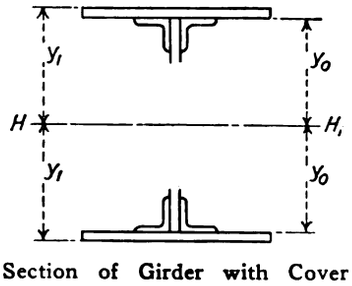
Fig. 1

A careful investigation of the information given in the books mentioned above is recommended.

Section Modulus for Girder with Cover Plates

Q. (1,251).—Will you please explain to me about finding the section moduli. I do not understand it as described in the following: "The section moduli for girder with cover plates may be readily found by remembering that the section moduli of that part of the girder, excluding cover plates, bears the direct ratio to the value given in the table that the depth, from out to out, of girders without cover plates bears to the depth, from out to out, of girders with cover plates."

A. (1,251).—The writer has been unable to find the book from which you quote and suggests, in the absence of first hand knowledge, that there may be some limiting clause which you have not mentioned but which explains or modifies your quoted statement. If there is no such clause, the statement appears to be in error. For, let the illustration represent the original girder with cover plates. For convenience ignore the central portion of the web plate. Then let I be the moment of inertia of the cross section without cover plates about the axis H H, and let y_0 be the distance from the axis to the outermost fibre. Then the section modulus is



Section of Girder with Cover Plates

$$Z_0 = \frac{I_0}{y_0}$$

Assume now that the cover plates are added and that I_1 is the new moment of inertia about H H_1 and y_1 the distance to the outermost fibre. Then let $Z_1 = \frac{I_1}{y_1}$ be the modulus of the new section.

If the statement which you quote be true and the value in the tables be either Z_0 or Z_1, then

$$\frac{Z_0}{Z_1} = \frac{2\,y_0}{2\,y_1}$$

But $y_0 = \frac{I_0}{Z_0}$ and $y_1 = \frac{I_1}{Z_1}$

Therefore $\frac{y_0}{y_1}$ should $= \frac{\frac{I_0}{Z_0}}{\frac{I_1}{Z_1}} = \frac{I_0 Z_1}{I_1 Z_0}$

In order that this may be true I_0 must equal I_1. This, it would appear, could seldom be the case in practice.

Lining Up Shaft Bearings

Q. (1,253).—Please advise me how to determine which shaft bearing is low, or out of line forward and aft, by the use of the tram shown in the sketch. The engine is of the beam type as installed in a double end ferry steamer. Suppose I jack the cranks apart, as shown, and place one end of the tram in line with the center of the shaft, and make a center punch mark on the web where the other end touches, then turn the engine on the opposite center and tram the cranks again and find that I am above or below the center punch mark with the tram, how am I to know if the shaft is low, assuming that my measurements have been taken on the top and bottom centers respectively? I want to be able to determine whether my main bearing, spring or outboard bearings are down and how much, also if the shaft is running too far forward or aft?—Engineer.

A. (1,253).—It is not quite clear how the tram as sketched with the round end can be used for this purpose. It seems that the two ends should be alike, that is pointed. It is assumed that the left hand web has been prick punched at the exact center of the shaft and that for trial the right hand bearing is low. As the jack holds the web parallel, the right hand web would then be forced downward. Now place the upper end of the tram in the shaft center prick punch hole and mark the web at the point "X." Turn the crank to the top dead center and repeat the operation. This second point will be found nearer the crankpin than the first. The half distance between these two points is the amount which the bearing should be raised. Should the position of these points be reversed for the bottom and top position it is evident that the bearing is too high.

Again let us consider the crank to be in a horizontal position pointing aft and the right hand bearing is too far aft. Place the tram as previously at the left hand shaft center and prick a point at "X." Now turn the crank to the for-

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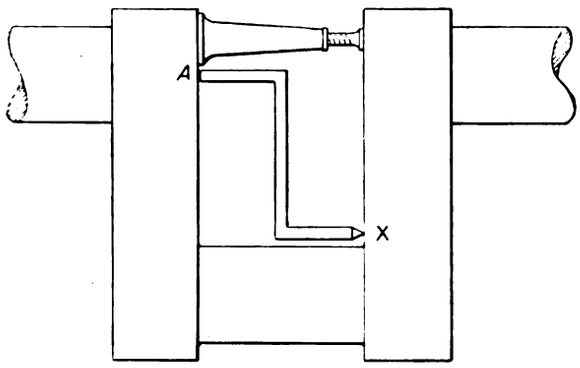
ward position and prick a second point which will be seen to fall nearer the crankpin than the first point. The half distance between these two points is the amount which the right hand bearing should be moved forward. Had these points been reversed in position we would know the bearing should be moved aft instead of forward as at first assumed.

The above tramming only shows whether one bearing is too high or low and too far aft or forward with reference to the other bearing. In other words the bearings may be bodily too high or too far aft in the ship. The jack should



Position of Tram With Cranks Jacked Apart

now be removed and the crank placed at bottom dead center and the distance between the crank webs at the shaft center measured. Turn the crank to the top center and again measure the distance between the crank webs. Should the first measurement be less than the last we are safe in assuming that the bearing is too low in the vessel and should be shimmed up until the two readings are equal. Should the former reading be greater than the latter the bearing should be lowered.

Take similar readings with the crank in horizontal positions and, if it is found the distance is less in the forward than in the aft position, the bearing should be moved aft until the readings are equal. Had the former reading been greater than the latter, it would have indicated that the bearings were too far aft.

Danger to Vessel of Changing Weight or Volume of Cargo

Q. (1,257).—In what way or ways may a vessel be endangered on a voyage by her cargo changing weight or volume?

A. (1,257).—Danger to a vessel from the sources you mention is, at present, ordinarily regarded as relatively unimportant among the hazards of shipping, although in a number of instances the loss of a vessel has been attributed directly or indirectly to just such causes.

This view is, perhaps, fully justified; due, in part at least, to the observance of more stringent shipping regulations and to the construction of vessels for special services.

Certain commodities as, for instance, coke and charcoal which may gain as much as 20 percent weight by absorbing moisture from the air, if stowed in large quantities on deck or high 'tween decks, may, by gaining weight, so seriously lessen the stability of a vessel under certain conditions of loading as to render her liable to capsize. Again, if such commodities were stowed near one end only of a vessel, a large increase in weight may result in a very undesirable change in trim.

Grains under the combined influence of heat and moisture may gain in volume to such an extent as to cause serious strains or even leakage in wooden or lightly constructed vessels. The swelling, however, is largely offset by the settling of the grain due to the rolling of the vessel. Settling in itself may prove a source of danger in that it affords space for shifting of the grain; consequently, properly constructed feeders should be provided in order to keep the compartment filled at all times. When shipped in a green or wet condition and stowed in a poorly ventilated space, the heat generated may be sufficient to cause it to ignite. For these reasons certain grains should not be loaded in a heavy fog.

Fuel oil is another commodity that expands upon being heated. If an oil tank were entirely filled, and then tightly closed, any considerable change in temperature of the oil would likely bring excessive stresses on the structure, causing leakage and serious damage. In order to provide against such contingencies among others expansion trunks into which the oil rises when heated are fitted at the tops of the tanks or else rigid precautions must be taken that the tanks are filled only to about 95 percent of their maximum capacity in order to allow sufficient room for expansion.

Care of Wood Decks During Lay-Up

Q. (1,260).—What care should be given wood decks on vessels laid up for a considerable period?

A. (1,260).—Exposed wood decks are subject to very rapid deterioration especially in hot dry weather. When a vessel is put out of service, if a skeleton crew is maintained on board or, if reliable caretakers are otherwise available, a daily wetting down of the decks in hot or dry weather with proper cleaning is sufficient. If a very long period of laying up is contemplated, the decks should be given a thick coating of pine tar and sawdust. Frequent examinations should be made to insure that the covering is intact.

Autogenous Welding

Q. (1,261).—Will you please explain what is meant by autogenous welding?

A. (1,261).—The term autogenous is generally applied to any method of welding whereby the union of two pieces of metal is accomplished by a direct fusion of one to the other in contradistinction to heterogeneous methods by which the union of the parts is effected by the intervention of another metal at the joint. Brazing and soldering are typical examples of the latter methods. The use of the term being applied to the result obtained, and not to the manner of its accomplishment, is applicable to various methods of welding now in use.

Weight of Anchors

Q. (1,262).—What is the relation between the weight of an anchor for a permanent mooring and the weight of an anchor which would be required by the Classification Society for the ship's ordinary equipment?

A. (1,262).—So far as the writer is aware there is no fixed relationship between the weight of the ordinary type of anchor and that used in a permanent mooring.

In the naval service it is customary to put down three anchors approximately 120 degrees apart with their chains brought to a common swivel to serve as a mooring. For this purpose the anchors used are generally of the same weight as those which would be specified for the equipment of the ship which it is intended to moor.

When the above type of mooring is not used but either a heavy mushroom anchor or a concrete block is adopted, the weight of the anchor or block should be made at least three times that of the weight of the ship's anchor. Of course, it should be recognized that weight for weight a mushroom anchor is much more efficient for holding than is an ordinary concrete block. The latter, however, is much less expensive.

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NEW BOOKS

CARGO HANDLING AT PORTS. By Brysson Cunningham. Size, 5½ by 8½ inches. Pages 180. Figures and folding plates, 124. New York, 1924: John Wiley & Sons, Inc.

The principles underlying the loading and discharging of ships' cargoes are clearly explained in this book. While the subject is too broad and complex to be exhaustively treated in a volume of this limited size, the book contains a considerable amount of interesting information and data relative to the handling of various classes of cargo and the types and capacities of machinery and hoisting gear employed at various ports.

ELEMENTARY HYDRAULICS. By F. W. Medaugh. Size, 5⅜ by 8 inches. Pages, 144, including index. Illustrations, 71. New York, 1924: D. Van Nostrand Company.

Designed primarily for the use of students this is a small and compact work, but it will be found useful by any engineer whose work calls for an occasional reference to the simpler problems of hydraulics. The various methods of measurement of the flow of liquids are clearly and concisely explained and a large number of problems serve to illustrate the practical application of the laws of hydraulics which are treated in the text.

DER SCHIFFSMACHINENBAU. By G. Bauer. Size, 8 by 11¼ inches. Pages, 157, including index. Numerous illustrations and diagrams. Munchen and Berlin, 1923: Verlag R. Oldenburg.

This is the first volume of a new edition of Dr. Bauer's monumental work on marine engineering, which treats of reciprocating engines and propellers. It is to be regretted that most American engineers have not sufficient command of technical German to take the fullest advantage of the large amount of valuable information which is contained in this book, and we trust that, as has been the case with Dr. Bauer's previous works, an English translation may be published.

PERSONAL MENTION

R. E. WHITMAN of the Vulcan Iron Works, Jersey City, N. J., has been promoted to the head of the industrial department and will be in charge of the sales.

J. F. SCHUMACHER, for four years Atlantic coast manager for the Dollar Line, has resigned, due to ill health. He will be succeeded by M. J. Buckley of San Francisco.

S. A. OYEN, vice-president and general manager of the Richmond-New York Steamship Company, has been appointed general agent of the Dollar Line at New York.

E. A. BRENNAN, formerly acting director of the New York district of the Emergency Fleet Corporation, has been appointed director of the district by President Palmer.

HARVEY C. MILLER, president of the Southern Steamship Company, of Philadelphia, has been elected a director of the Atlantic, Gulf & West Indies Steamship Lines.

J. H. MCINTYRE has been appointed traffic manager and manager of the New York office of the Consolidated Navigation Company. W. W. Schwenk has been made assistant manager.

M. F. CROPLEY, assistant general freight agent of the Pacific Steamship Company, has been elected by the intercoastal eastbound conference to succeed George Yater as chairman.

HARRY E. STOCKER has resigned his position as general freight agent for W. R. Grace & Company, San Francisco, and accepted the position of New York resident manager for the McCormick Steamship Company.

HAROLD V. PAGET, until recently with the Dollar Steamship Line, has been appointed traveling representative in the freight contracting department of the United States Australasian Steamship Company.

LAWRENCE DEVINE, assistant freight manager of the United States Lines, has joined the staff of the American Merchant Lines in the same capacity. H. Berke and P. J. McManus will also join the American Merchant Lines.

CARL E. PETERSEN, recently resigned as naval architect in charge of the United States Lines' technical department, has returned to the east after an extended trip to the Pacific Coast and has become associated with the United Dredging Company as designing engineer in connection with their extensive operations at Galveston. Mr. Petersen received his education as mechanical engineer at Pratt Institute and Polytechnic Institute, Brooklyn, N. Y., later graduating from the United States Navy Steam Engineering School. After serving an apprenticeship in the machine shops of the Morse Dry Dock and Repair Company, he became draftsman, estimator and finally outside superintendent which position he held for 3 years. Mr. Petersen left the Morse Company after a service of 8½ years to accept a commission in the United States Navy as engineer officer during the world war; after the armistice, he was superintendent engineer in the Army Transport Service during the period of conversion of cargo vessels to troop ships and their subsequent reconversion. Upon the completion of this work, Mr. Petersen became estimator for the Construction and Repair Department of the Shipping Board, having charge of estimates and the costs of repairs in the New York district. When the United States Mail Steamship Company was formed, he became assistant naval architect and later naval architect, retaining that position for several years after the vessels' operation was taken over by the United States Lines. During this period, the liners *George Washington, America,* and other ex-German vessels were reconditioned for passenger service as well as extensive alterations planned and carried out on the *President Harding, President Roosevelt* and the 502-foot vessels formerly in the London service. Mr. Petersen is a member of the American Society of Naval Engineers, the Society of Naval Architects and Marine Engineers, and the American Society of Mechanical Engineers as well as a licensed marine engineer for ocean vessels of any tonnage.

Carl E. Petersen

THOMAS RICE, member of the firm of Fowler & McVitie, steamship agents and brokers of Galveston, Texas, resigned his connection with this firm June 30 to re-establish the firm of Thomas Rice & Company. This company will have the agency of the Nervion Line at the Texas port.

WILLIAM H. TODD and JOHN D. REILLY, whose terms of office as directors of the Todd Shipyards Corporation expired, were re-elected for a further period of four years. J. Herbert Todd, president of Clinton Drydocks, Inc., was elected a director to succeed Arthur E. Goddard, resigned.

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W. V. BECHTOLD, formerly sales manager of the Vulcan Iron Works, Jersey City, N. J., has established the Industrial Iron Works, 359 Van Horn street, Jersey City, N. J., to engage in general boiler and engine work. The new plant comprises a machine shop, boiler shop and blacksmith shop.

DR. WILLIAM F. DURAND, professor of mechanical engineering at Leland Stanford University, has been nominated president of the American Society of Mechanical Engineers. Formerly Dr. Durand was head of the course in naval architecture and marine engineering at Cornell University and at that time was consulting editor of MARINE ENGINEERING AND SHIPPING AGE.

COLONEL E. J. M. NASH, former general agent on the Pacific coast for the Royal Mail Steam Packet Company, has organized the North Pacific Steamship Agencies Limited, Inc., for the purpose of engaging in a general shipping business along the coast. The offices of this company will be at Vancouver, Seattle, Portland and San Francisco. Colonel Nash has been elected president, Captain C. A. Goring, vice-president, and C. C. Kernahan, secretary.

OBITUARY

CAPTAIN JOHN H. COWAN, founder of the Neptune Association, died June 11 as a result of injuries received in a fall into the hold of the Bull Line steamship *Hilton* the day before.

WILLIAM C. LIGHTFOOT, head of the claims department of the Old Dominion Steamship Company, died of heart disease on June 3. He had been with the Old Dominion Line twenty-three years.

HORACE MONROE SWETLAND, president of the United Publishers Corporation and one of the leading business publishers of the country, died at his home at Upper Montclair, N. J., on June 15. At the time of his death besides being president of the United Publishers Corporation, Mr. Swetland was also president of the Class Journal Company, president of the Federal Printing Company, president of the U. P. C. Realty Company, and the Swetland Realty Company, all of New York. He was also president of the National Publishers Association and chairman of the Educational Committee of the Associated Business Papers, Inc. Mr. Swetland was born in Allegheny County, New York, November 16, 1853, and started in life as a school teacher at the age of 17. He came to New York in 1881 to represent the Boston Journal of Commerce. He entered the business paper field in 1884 as Boston representative of *Power* and later came to New York as manager of that publication. In 1888 Mr. Swetland purchased *Power* and ran it for seventeen years, when he sold it to John Hill. While he was still publishing *Power* he, with two other associates, one of whom was H. L. Aldrich, started MARINE ENGINEERING. About a year later Mr. Swetland sold his interest in this publication, now known as MARINE ENGINEERING AND SHIPPING AGE, to Mr. Aldrich. In 1902, Mr. Swetland purchased *The Automobile* and consolidated it with the *Motor Vehicle Review*. A year later he acquired the *Dealer and Repairman* and the *Automobile Magazine*. The *Automobile Blue Book* was purchased in 1904. The next important step was the purchase of *Motor Age* in 1907. In the same year he founded the *Commercial Vehicle*. In 1915, *Motor World* was purchased and *El Automovil Americano* was started in 1917. It was in 1911 that Mr. Swetland joined with others in forming the present United Publishers Corporation, of which he continued as president until his death.

Horace Monroe Swetland

LIEUTENANT-COLONEL THOMAS A. BUFF died suddenly on Saturday, May 24, at Toronto. He was secretary-treasurer of the St. John Dry Dock & Shipbuilding Company, Ltd., and a director of the Canadian Dredging Company, as well as director of the Great Lakes Transportation Company.

REAR ADMIRAL CHARLES HERBERT STOCKTON (retired) head of the Naval War College and former president of George Washington University, died June 1. He was widely known as an authority on naval affairs and international law and was the author of many books and papers on both subjects.

VISCOUNT WILLIAM JAMES PIRRIE, chairman of the Board of Directors of the firm of Harland & Wolff, Belfast, Ireland, died June 7 on board the Pacific Steam Navigation Company's liner *Ebro* while on his way from South America to New York. Lord Pirrie was born at Quebec, Canada, May 31, 1847. While still very young he was taken to Belfast, Ireland, where he attended the primary schools and the Belfast Royal Academical Institution. When only 15 he became a premium apprentice with the Harland & Wolff Works where only 100 men were then employed. Sir Edward Harland in a very short time realized that the young apprentice had the making of a great shipbuilder and so advanced him rapidly. At the time that the *Oceanic* was designed in 1869 Pirrie was chief draftsman of the plant. Five years later, and but twelve years after he had left the academy he was taken into partnership and in a few years became chairman of the Board of Directors. During the world war his services to the allies were first given as commercial and financial adviser to Lord Derby, Secretary of State for War, in connection with the acquisition of war supplies. In March, 1918, Sir Eric Geddes, First Lord of the Admiralty, announced that Lord Pirrie had been appointed comptroller general of merchant shipping. In this office he rendered valuable service during the closing months of the war. In his activity as the head of Harland & Wolff, Lord Pirrie built many of the ships for the White Star, Red Star, Atlantic Transport, Dominion and Leyland Lines, in which companies he had large holdings. It was mainly through his interest in the project that these companies were sold to the late J. P. Morgan and formed into the combination of shipping interests known as the International Mercantile Marine. Lord Pirrie's shipping activities extended to every quarter of the globe, but he was particularly interested in African and South American lines in addition to transatlantic service. It is said that at the time of his death he was a director in more than forty companies, including shipbuilding, shipping, railway, engine building, public service, petroleum products and others.

Viscount Pirrie

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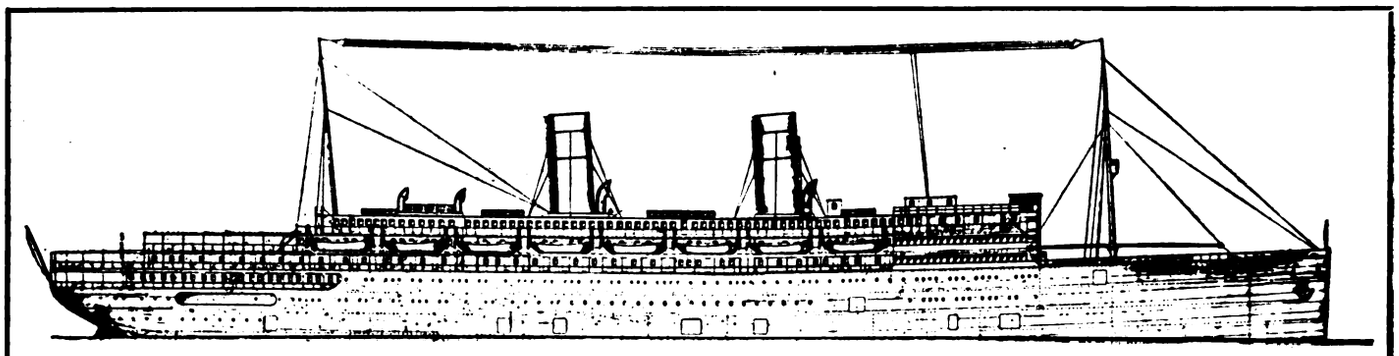
The Month's Shipping and Shipbuilding News in Brief

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries



Outboard Profile of New Ship for Matson Line

Construction of New Ferries Recommended For N. Y. City Lines

FOLLOWING the award of a contract for three ferryboats each to the Staten Island Shipbuilding Company and the Tebo Yacht & Basin Company by the Department of Plant and Structures of the City of New York, at a total price of $1,490,040, Commissioner Grover A. Whalen has recommended to the Commissioners of the Sinking Fund and to the Board of Estimate and Apportionment, an issue of corporate stock in the amount of $820,000, for the construction of a new ferryboat of the *President Roosevelt* type, for service to Staten Island. The vessel proposed will be built of steel and will be an oil burner.

In another report to the Board of Estimate and Apportionment, Commissioner Whalen recommends the re-organization of the Institutional Boat Service, such re-organization to reduce the number of lines from nine to six, this plan requiring the building of four steel screw ferryboats of the *Bird S. Coler* type, steam driven, burning fuel oil, at a cost of about $100,000 each.

Contract for Construction of Matson Navigation Company Steamship Placed with Cramp Shipyard for $4,792,000

THE award of the contract for the construction of a combination passenger and freight ship for the Matson Navigation Company, San Francisco, has finally been made to William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., who submitted a bid of $4,792,000 for the work, the vessel to be completed in 2 years.

Bids were opened June 16, the tenders ranging from $4,792,000 to $6,160,000 with the time of completion from 22 to 27 months. The William Cramp & Sons Ship & Engine Building Company, the Bethlehem Shipbuilding Corporation, Ltd., and the Newport News Shipbuilding & Dry Dock Company were the three concerns which submitted bids, each one quoting on detailed specifications individually prepared.

This ship, designed by A. C. Dieriex, vice-president and assistant general manager of the Matson Line, is expected to more than double the line's passenger carrying capacity. She will be built for the account of the American-Hawaiian Steamship Company under terms and conditions imposed by section 23 of the Jones Act and, after completion, will be purchased by the Matson Navigation Company and placed in express service between San Francisco and Hawaii. The specified speed of 21 knots is expected to cut the voyage between San Francisco and Honolulu to about 4½ days. Two trips a month will be made as compared with one now made by the company's fastest steamers.

General Details of Liner

The vessel will be 578 feet in length, 75 feet beam and will displace 17,500 tons. Propulsion will be by General Electric turbo-electric machinery rated at 24,000 horsepower. Electricity is to be used throughout the ship for auxiliary purposes, including the preparation of foods.

Passenger Accommodations

The steamer will carry first-class passengers exclusively, accommodations being provided for a total of 500. A large number of accommodations will be arranged in suites, and many of the rooms will have baths and showers. The furnishings, design, and equipment of the rooms will follow the practice of the most modern American hotels.

All the public rooms are located on one deck and include a social hall, smoking room, reading and writing rooms, and veranda. A generous allowance of deck space has been made to provide for deck sports and promenading. All public rooms and staterooms will be equipped with the best systems of mechanical ventilation and, while the ship is in Hawaii's semi-tropical waters, refrigerated air will be circulated in the dining saloon and other public rooms. Two passenger elevators will operate from the reception room to the public rooms, serving four decks.

The dining room has been planned to accommodate all passengers at one sitting. Immediately connecting with the dining room is

Construction of New Combination Freight and Passenger Ships Under Consideration by Shipping Board

THAT the Shipping Board has under consideration the construction of five combination passenger and freight ships of a most improved type, in addition to the two passenger steamers, which it was announced some time ago the Board was contemplating, was the statement made by E. C. Plummer, Shipping Board vice-chairman, at a dinner of steamship agents on board the steamship *Leviathan*, at New York, on Wednesday, June 11. After a general discussion of the shipping situation, Mr. Plummer said in conclusion:

"And let me tell you this in closing—today the Shipping Board has before it the completed plans for two passenger steamships which in design and provisions for luxurious comfort and efficiency as servants of the flag, will be unsurpassed. Not only that, but the Special Committee appointed by the Chief Executive and made up of national leaders in industrial and transportation affairs is recommending five other vessels of the most improved combination passenger and freight ships; so that you can look forward to having in the immediate future a magnificent addition to the fleets which you now serve, and you can tell your clients and the world, as well, that the United States is on the ocean to stay."

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a large reception room which may be used in connection with the dining room for special parties and will be available in the evening for dancing, card parties, and musicales. For the athletically inclined there will be a tile swimming pool of generous size and a gymnasium adjoining.

Ample room will be provided for passenger automobiles and baggage. Only express freight and refrigerated cargo will be carried.

The owners will supply the linen, crockery, glassware and silver.

Specifications Under Way for Twin Screw Diesel Cargo Boat

GEORGE G. SHARP, naval architect of 30 Church Street, New York, has in hand for Great Lakes owners plans and specifications for the construction of a twin screw motor vessel to operate on the Great Lakes, the New York and Welland canals. The vessel is to have a length of about 250 feet and will be propelled by Diesel engines of approximately 400 brake horsepower each.

Floating Equipment Planned

According to latest reports, C. E. Smith, city engineer of Shreveport, La., submitted plans to Mayor L. E. Thomas, for the following improvements to river terminals and floating equipment, etc.:

Two towboats, $320,000; 10 barges, $200,000; submerged dyke (Bossier side), $40,000; 12-foot piling (City side), $50,000; 100,000 square feet bank paving, $20,000; landing platform, $5,000; warehouse, $30,000; four conveyors, $30,000; tracks and platforms, $5,000; contingencies, etc., $30,000.

Bids July 7 for New Steel Steamer Hull

The United States Engineer Office, Nashville, Tenn., will receive sealed proposals until 11 A. M., July 7, for the construction and delivery of one steel steamboat hull for *U. S. S. Colbert*. The hull is to be delivered afloat at Sheffield Landing, Ala.

The boat is to have a length overall of 138 feet 6 inches; length, molded, 120 feet; breadth, molded, 26 feet; depth at side, molded, 4 feet 5 inches.

Wants to Rent Deck Barges

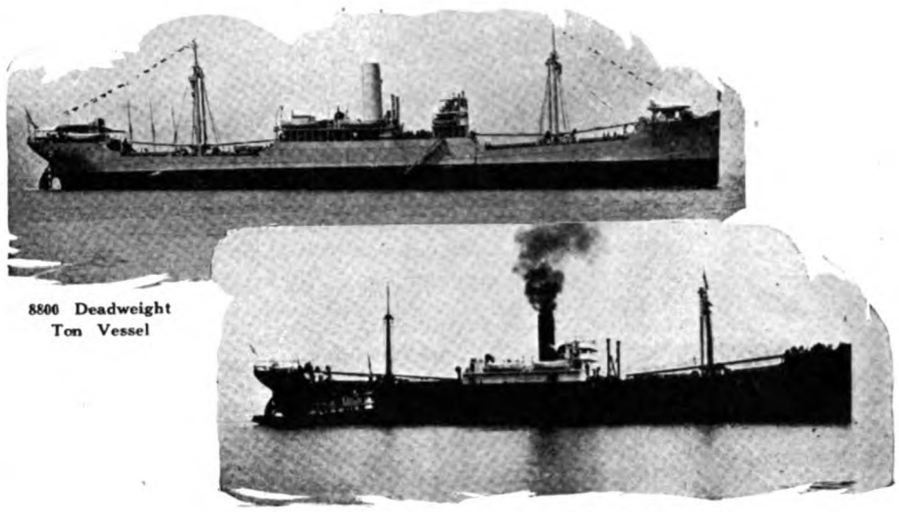
The United States Engineer Office, 1st and 2nd Mississippi River Commission Districts, Memphis, Tenn., desires to rent for six months about 20 decked barges, around a size of 130 by 20 by 7 feet.

Steel Hulls Planned

Steel hulls are being planned by the Green Line, Sycamore Street, Cincinnati, Ohio, for its steamer *Greenwood* and for the Maysville, Ky., ferryboat.

New Towboat

The United States Engineer office, Montgomery, Ala., has prepared plans and specifications for a towboat and bids will be asked for in the near future.



8800 Deadweight Ton Vessel

9400 Deadweight Ton Moore Type

Types of Shipping Board Vessels Selected for Diesel Conversion

Diesel Conversion Program Ready; Shipping Board Has Selected Twelve Vessels for Immediate Conversion

IN ACCORDANCE with preliminary plans for the Dieselization of vessels of the United States Shipping Board's idle fleet, as authorized by the amendment of Sections 11 and 12 of the Jones Act, just passed by Congress, twelve vessels have been selected for immediate conversion. Six are of the standard 8,800 deadweight ton type and six of the 9,400 deadweight ton Moore type. These vessels will be fitted with single screw engines of approximately 2,600 shaft horsepower, operating at 90 revolutions per minute, which should give an average speed of about 11 knots fully loaded.

According to present indications these vessels will be divided into three or four groups and each group fitted with the same type of engine. These vessels, at present in lay-up, are in an excellent state of preservation and their selection is predicated on the low estimated cost of hull repairs. They are all capable of yielding satisfactory service speeds on their present shafting and with a minimum of structural changes.

The selection of the most suitable engines will logically be the first step. In general, the Shipping Board policy will be inspired by the desirability of promoting a domestic Diesel industry, but for the initial program, outlined above, only engines of proven reliability will be used and the builders must unequivocally assume full responsibility for their satisfactory performance. To assist the Board in this delicate task, an advisory committee has been selected, the personnel of which is announced elsewhere in this issue.

Electrically driven engine and deck auxiliaries will be used throughout. By a process of standardization and a system of centralized purchasing on a competitive basis it is hoped to secure high-grade equipment at reasonable prices.

The first 12 vessels will be converted into successful and efficient motorships at the earliest practicable date and they will be placed in operation on some of the essential long distance trade routes. While further activities will necessarily depend on the outcome of the first effort, it has been generally agreed to spread the available funds over a period of about five years.

Plans are also being matured for training the operating personnel and considerable study and thought have been given to the many varied problems arising in this conversion program.

Bids Pending on Half Million Dollar Job on Steel Yacht Hirondel

BIDS are being taken by the firm of Cox & Stevens, naval architects, for the reconditioning of the ocean-going steam yacht *Hirondel* owned by W. R. Hearst and formerly owned by the Prince of Monaco. The specifications provide for a thorough overhauling of the vessel and it is believed that the total cost will involve an expenditure of from three to five hundred thousand dollars.

Tenders Received for Construction of Tankers for Gulf Refining Co.

BIDS are being taken by the firm of Kindlund & Drake, naval architects of 17 Battery Place, New York, for the construction of several tank steamers for the Gulf Refining Company. The vessels will be steam driven with reciprocating engines.

It is understood that more than one type of vessel is under consideration, but information was withheld regarding the details of the ships, or the exact number to be built. It is believed that some action will be taken within the next two weeks.

George Clarke, of Cramp's shipyard, was recently given a testimonial dinner at the Philadelphia Yacht Club in celebration of his twenty-fifth year as manager of the company's Kensington yard.

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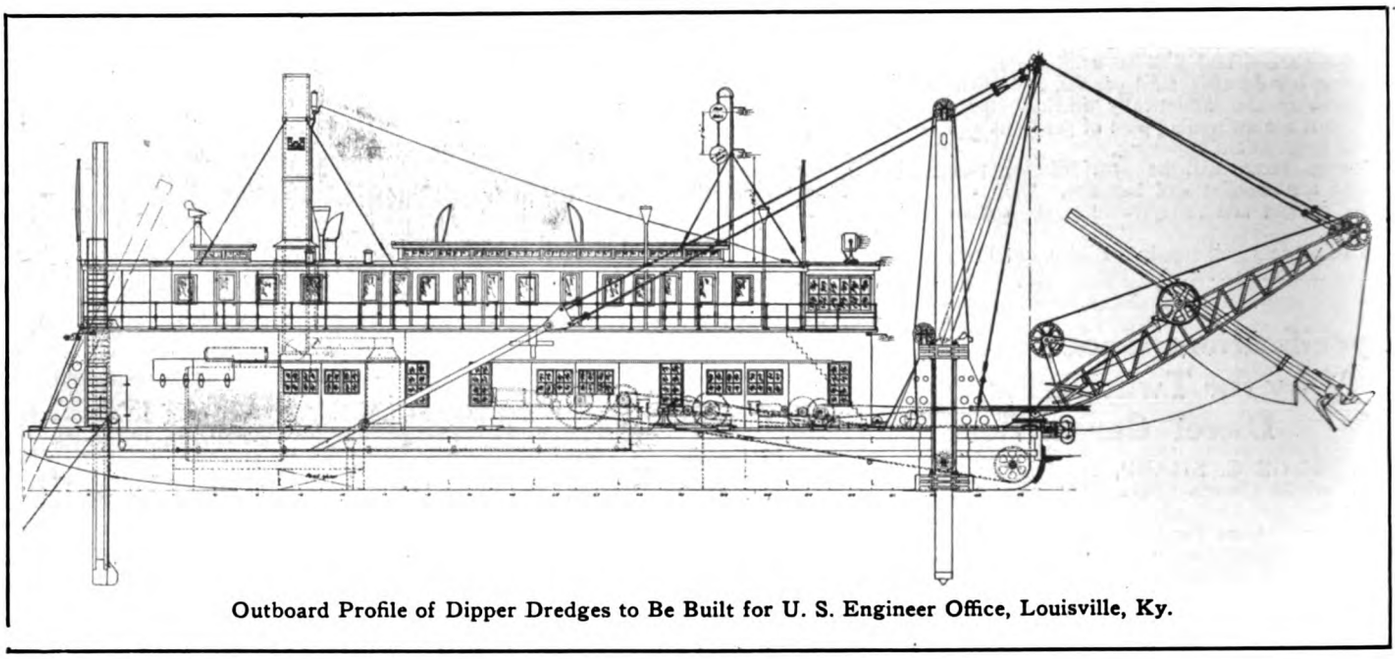

Outboard Profile of Dipper Dredges to Be Built for U. S. Engineer Office, Louisville, Ky.

Louisville Engineer Office to Take Bids for Three Dredges

PLANS and specifications for the construction of three steel hull four-yard dipper dredges are expected to be issued in the near future by United States Engineer Office at Louisville, Ky. Two of the dredges are to be complete with machinery and are for use in the Louisville district, the third boat being built to replace the old dredge *Watauga*, the machinery from the latter vessel to be transferred to the new hull when completed. This boat will be used in the Nashville, Tennessee, district. Award of contract will be made for one, two or three dredges, as may be most advantageous.

DIMENSIONS

The vessels are to have a length overall of 120 feet 7½ inches; length of hull, molded, 120 feet; breadth overall 36 feet 2½ inches; breadth, molded, 36 feet; depth, molded, 7 feet. The forward spuds are to be 55 feet long, built of 7/16-inch plate with 6-inch by 6-inch corner angles and the after spuds are to be 52 feet long, 20 inches by 20 inches yellow or Oregon pine, with corner angles.

EQUIPMENT

For the two dredges to be built complete the machinery and equipment will include the following: main hoisting engine 13 inches by 16 inches, swinging engine 9 inches by 9 inches, boiler, superheater, feed pump, fire and bilge pump, boiler injector, feed water heater, one-half ton refrigerating machine, two dippers and dipper handles, five kilowatt electric lighting set, traveling crane with two-ton hoist, water filter, galley range, two capstans (double barrel, steam driven), bull wheel, boom, forward spud engine 9 inches by 9 inches, after spud engine 6 inches by 7 inches, valves, etc.

Steel Barge

Bids were received by George Sharp, naval architect of 30 Church Street, New York, on Tuesday, June 17, for the construction of a 110-foot steel barge.

Contracts Awarded for $3,500,000 Worth of Coast Guard Patrol Boats; 14 Yards Start Building Activities

CONTRACTS totaling over three and one-half million dollars in value have been awarded by the Coast Guard Headquarters, Washington, D. C., for the construction of one hundred and fifty 75-foot patrol boats of a total of one hundred and seventy-five boats, bids for which were received on May 19th. According to the latest announcement from the Coast Guard, thirteen private builders and one navy yard were given as the successful bidders to whom contracts have thus far been awarded. A complete list of the proposals was published in the June number. The successful contenders, the number of boats awarded each, and the prices per boat, are announced as follows:

Mathis Yacht Building Company, Camden, N. J., fifteen boats at $18,675 each; Defoe Boat and Motor Works, Bay City, Mich., fifteen boats at $20,375; Crowinshield Shipbuilding Company, Fall River, Mass., ten boats at $21,450; Dachel-Carter Boat Company, Benton Harbor, Mich., ten boats at $21,950; T. H. Soule, South Freeport, Maine, ten at $22,945; New York Yacht, Launch and Engine Company, Morris Heights, New York, ten at $23,600; Rice Bros. Corporation, East Booth Bay, Maine, ten at $23,950; Southern Shipyard Corporation, Newport News, Va., ten at $24,000; Kingston Dry Dock & Construction Company, Kingston, New York, ten at $24,750; Vineyard Shipbuilding Company, Milford, Del., ten at $24,770; Colonna Shipyard, Inc., Norfolk, Va., ten at $25,000; Luders Marine Construction Company, Stamford, Conn., ten at $25,675; Gibbs Gas Engine Company, Jacksonville, Fla., ten at $26,900; and United States Navy Yard, Norfolk, Va., ten at $27,700.

Midwest Boat Company Low Bidder on Barge for U. S. Engineer

THE Mid-West Boat and Barge Company, Grafton, Ill., was low bidder for one 80-foot steel barge for United States Engineer Office, Chicago, according to proposals opened at Chicago, Illinois, June 2, 10 A. M. The tenders submitted were as follows:

Mid-West Boat and Barge Company, Grafton, Ill.	$10,731
Dubuque Boat & Boiler Works, Dubuque, Iowa	13,800
The Dravo Contracting Company, Pittsburgh, Pa.	14,450
Manitowoc Shipbuilding Corporation, Manitowoc, Wis.	15,900
Sturgeon Bay Drydock Company, Sturgeon Bay, Wis.	15,950
Midland Barge Company, Midland, Pa.	16,800

Sun Shipbuilding Co. Low Bidder for Conversion Contract

WITH a price of $323,000, the Sun Shipbuilding and Drydock Company of Chester, Pa., submitted the lowest bid for the reconditioning of the steamer *Mary Weems*, of the Baltimore Steamship Company, Baltimore, Md., at the opening of tenders on Thursday, June 12. The specifications provide for the conversion of the steamer into a combination pasenger and freight ship similar to the *Esther Weems* which recently underwent like conversion. The bids opened on June 12 were as follows:

Sun Shipbuilding Company	$323,000
New York Shipbuilding Corp.	339,510
Federal Shipbuilding Company	360,000
Bethlehem Shipbuilding Corp.	366,000
Newport News Shipbuilding Co.	387,500

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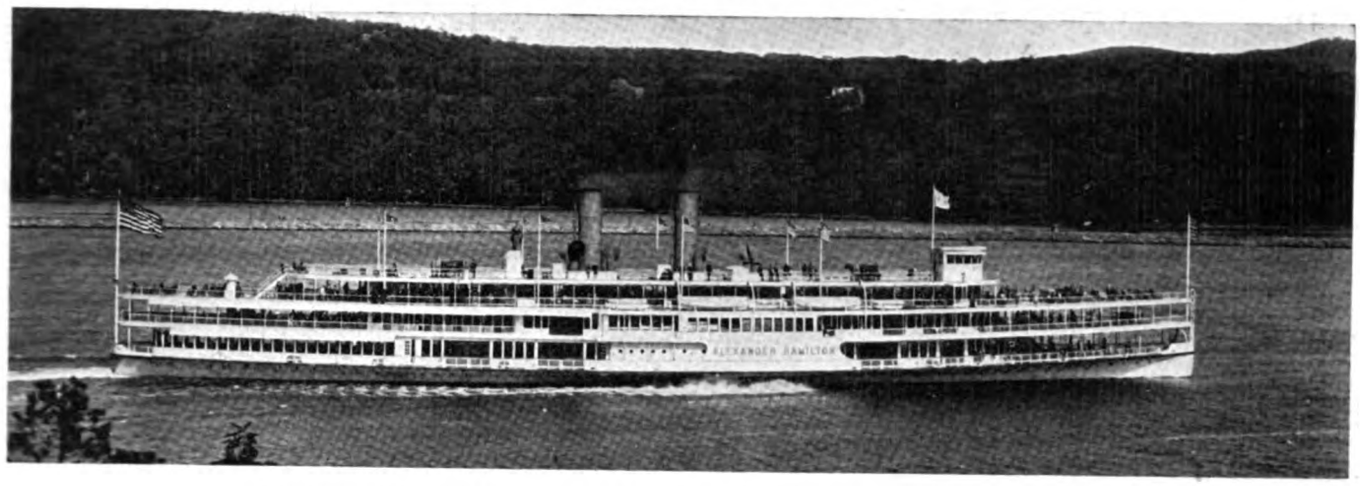

S. S. Alexander Hamilton, Latest Addition to the Hudson River Day Line Fleet

New Hudson River Day Line Steamer Goes Into Service

THE steamer *Alexander Hamilton* recently completed by the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation is now in service and on June 13 was given an exhibition run to Indian Point on the Hudson, which was attended by a number of persons, prominent in shipbuilding and shipping circles.

The new steamer, while approximately of the same size and capacity as the *Robert Fulton*, represents a distinct step in advance of the former vessel and is, in effect, a reproduction, on a reduced scale, of the *Washington Irving*, the "crack ship" of the Hudson River Day Line.

The general particulars of the vessel are as follows:

Length over all	348 feet
Length between perpendiculars	334 feet 6 inches
Beam over guards	78 feet
Beam molded	42 feet
Depth molded	13 feet 8 inches
Designed load draft, mean	8 feet 1 inch

Engines, 3 cylinder triple, inclined, 36½ inches by 57 inches by 85 inches by 72 inches stroke.
Paddle wheels, 22 feet 6 inches diameter, 9 floats, 12 feet 6 inches by 3 feet 9 inches.
Boilers, 2 double end, 12 feet 1 inch diameter by 22 feet, and 2 single end, 12 feet 1 inch diameter by 11 feet 3 inches; working pressure 180 pounds per square inch; oil fuel burners (Peabody system).

A full description of the *Alexander Hamilton* will be published in an early issue.

Bids Asked for Damage Repairs to Light Vessel No. 68

SEALED proposals were received at the office of the Superintendent of Lighthouses, Staten Island, New York, until 2 P. M., June 10, for repairing damage done to Fire Island light vessel *No. 68*, recently in collision with the steamship *Castilian*. The damaged parts include deck planking, steel frames, hull planking, deck carlines, steel bulwark plates, rudder, sheathing metal, staterooms, etc. The vessel is 123 feet long overall, 28 feet 6 inches beam, molded, and 590 tons displacement. The order for the work will be placed by the Norton-Lilly Company, agents for the steamship *Castilian*, and the work will be done under the supervision of a representative of the Lighthouse Service.

Contract for Diesel Steel Yacht Awarded Newport News Yard

A CONTRACT for the construction of a steel sea-going Diesel propelled yacht for Alfred I. DuPont has been awarded to the Newport News Shipbuilding & Drydock Company, Newport News, Va. The vessel will have a length of 130 feet, beam 22 feet and it is understood that when completed she will cost close to $225,000.

Diesel Engine Contract for Brooklyn Navy Yard

The Brooklyn navy yard has obtained the contract for the construction of three Diesel engines for a new minelaying submarine, at an estimated cost of $250,000.

To Build Coal Dock

The Philadelphia & Cleveland Coal Company, Huntington, W. Va., plans to build a coal loading dock at Huntington.

Porto Rico Line Contract for Newport News Company

ANNOUNCEMENT of the award of a contract for the construction of a new passenger and freight ship for the New York and Porto Rico Steamship Company to the Newport News Shipbuilding and Drydock Company, of Newport News, Va., involving a probable expenditure of over two million dollars, is expected within a short time. Negotiations by the officials of the steamship company and the shipyard have been under way for some time and it is learned officially that while the contract has not yet been actually signed, there is every indication that it will be consummated very shortly.

The new vessel will be a modern freight and passenger ship, 415 feet in length, driven by turbine engines and designed by Theodore E. Ferris, naval architect and marine engineer, of 30 Church Street, New York.

New Diesel Contract Awarded The Globe Shipyard at Buffalo

THE Connelly Transportation Company, of Buffalo, recently organized by William H. Connelly, a Buffalo marine lawyer, formerly with Harvey D. Goulder, attorney, of Cleveland, and also a vessel agent in Buffalo, has contracted with the Globe Shipbuilding Company, of Buffalo, for a new Diesel twin screw 800-brake horsepower motor ship. The ship will be named the *John Connelly*, after the veteran ship chandler, and will be capable of carrying 90,000 bushels of grain on a 14-foot draft to Montreal and 60,000 bushels from Buffalo to New York on a 10-foot draft.

$328,320 Contract Placed For Building of 15 Rum Chasers

THE government has awarded the Moore Drydock Company, of Oakland, Cal., a contract for the building of fifteen speedy rum chasers, at a price of about $21,888 per boat, making an approximate total of $328,320 for the fleet of fifteen. Other bids received were: A. W. de Young, $21,993 each; Mare Island Navy Yard, $22,-162 each, Barrard Shipyards, Seattle, $22,-800 each.

Contract Awarded for Tanker Oil Engines

The Ingersoll-Rand Company, 11 Broadway, New York, is building for the Atlantic Refining Company, the oil engines which will be used in the conversion of a tanker to be named *J. W. Van Dyke*.

This tanker, which was purchased by the Atlantic Refining Company from the Shipping Board, has a deadweight tonnage of 7,057 tons; length overall 385 feet; cargo capacity of approximately 60,000 barrels of oil.

The power plant will consist of three Ingersoll-Rand oil engines of the direct-injection type. Each engine is direct-connected to a Westinghouse generator. A 2,300 horsepower 100 revolutions per minute Westinghouse double armature motor will be used to drive the vessel through a single screw.

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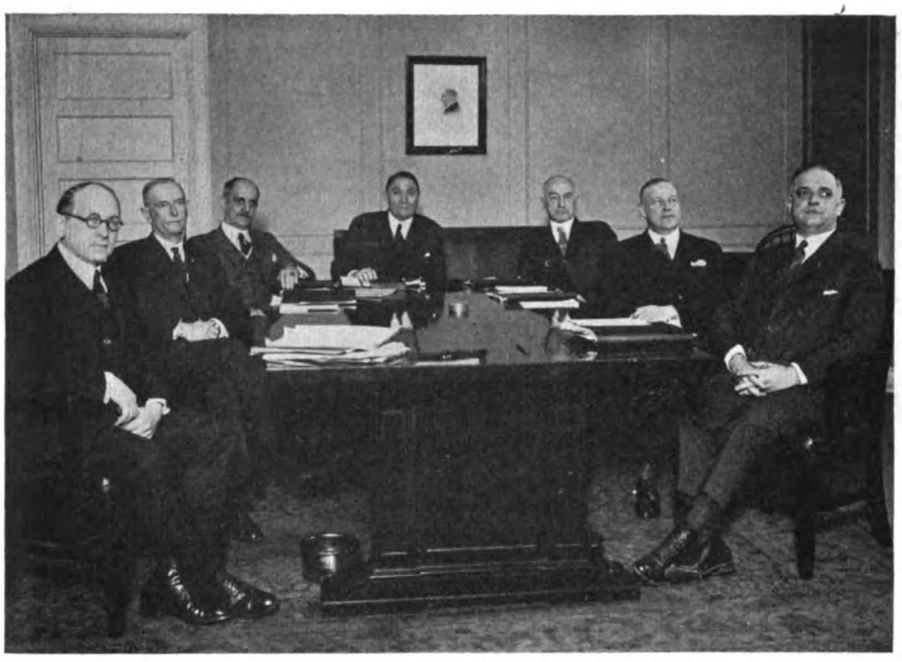

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United States Shipping Board in Session

Left to right: Meyer Lissner, of California; W. S. Hill, of South Dakota; E. C. Plummer, of Maine, vice-chairman; T. V. O'Connor, of New York, chairman; W. S. Benson, of Georgia; F. I. Thompson, of Alabama, and Bert E. Haney, of Oregon.

Marine Standards Committees Make Rapid Progress

FIVE committees of experts in various phases of marine construction and operation who have been spending some time in studies preliminary to efforts to bring about improvements to American shipping through greater standardization met last month in Philadelphia and New York, according to an announcement by the Division of Simplified Practice, Department of Commerce, Washington, D. C., which is working in co-operation with the American Marine Standards Committee toward this end.

On June 11 a subject committee on design of chocks under the chairmanship of W. R. Bean, assistant naval architect of the New York Shipbuilding Corporation, of Camden, N. J., held its second meeting in the offices of the Emergency Fleet Corporation. Progress in the survey of this item of construction was considered.

Two meetings were held at the offices of the Shipping Board in New York on June 12. In the morning a subject committee on the design of shafting, propeller hubs and shaft bearings met under the chairmanship of W. W. Smith, chief engineer of the Federal Shipbuilding and Dry Dock Company, Kearney, N. J. In the afternoon another committee on the care and operation of main engines and condensers under the chairmanship of W. L. Bunker, superintending engineer of the United States Lines, met.

On June 13 a committee on the standard design of air ports and dead lights, the chairman of which is John C. Craven, naval architect of the Federal Shipbuilding and Dry Dock Company, prepared a report on conclusions as to tentative standards. This report will be made to the American Marine Standards Committee's technical committee on hull details; and, if accepted by that group, will be submitted to all shipping interests for indorsement. This subject committee has had two previous meetings.

A second meeting was held on the afternoon of June 13, when a subject committee on operation of ships, under the chairmanship of Robert F. Hand, assistant manager of the marine department of the Standard Oil Company of New Jersey, continued studies, previously begun, of efforts to simplify the operation of ships as a business institution rather than as to nautical or mechanical operation.

These subject committees are part of a group of 16 named last year by the American Marine Standards Committee as part of its effort to bring about closer co-operation with shipping interests in simplification or standardization of the present diversity in items of hull detail, ship equipment, engineering and other matters. The conclusions reached by some of the other subject committees are in the hands of technical committees for review before being brought before the entire marine field for adoption.

Early this year 22 more subject committees were formed, the work of the American Marine Standards Committee broadened in its scope and steps were taken recently for the formation of a Pacific Coast panel to consider possible standardization along lines wherein the practice of the Pacific shipping industry is different from that of the Atlantic.

Lake Torpedo Boat Company's Yard Sold

ACCORDING to information received, the Lake Torpedo Boat Company's submarine plant at the foot of Seaview Avenue, Bridgeport, Conn., has been sold for $200,000. The name of the buyer has not as yet been made public. The company expects to maintain offices at Bridgeport and will compete for Government business, but will use other shipyards for construction work.

French Shipbuilders Face Dull Period

By Our Paris Correspondent

THE nearly total dearth of orders for new vessels continues to be the feature of the present position of the shipbuilding industry in this country.

In my article in the June number I referred to the launching of the *D'Artagnan*, the largest ship now under construction on this side, a photograph of which is reproduced in this issue. The vessel is expected to be completed early in 1925. I alluded also to the launching of the *Champollion*, another passenger steamer, of smaller dimensions, built to the order of the Messageries Maritimes. In addition to the *D'Artagnan* and the *Champollion*, there are three other passenger vessels under construction to the account of the same company, the *Explorateur-Grandidier*, at the Saint-Nazaire yards of the Chantier et Ateliers de Saint-Nazaire-Penhoet, the *Mariette-Pacha*, a sister ship of the *Champollion*, at the La Ciotat yards of the Societe Provencale de Constructions Navales, and a passenger vessel, which has been provisionally named *Mediterranee-Nord*, which is to be the first French motor passenger vessel. This vessel will have a displacement of 11,000 tons and is under construction at the Dunkirk yards of the Chantiers de France.

Sulzer Diesel engines will be installed, of 4,380 horse power, giving the ship a service speed of 15 knots.

No New Orders Placed

The dearth of orders for new tonnage above referred to is due to the fact that the building programmes on which most of the French steamship companies embarked shortly after the war are now completed, and they have now at their disposal a sufficient number of vessels in view of the prevailing depression in shipping affairs.

As regards the Compagnie Generale Transtlantique, its building programme is nearing completion and it has no vessel under construction in France: The delivery of the liner *De Grasse*, built by Messrs. Cammell Laird, will be somewhat delayed as a result of the lock-out which took place some weeks ago in British yards. It is learned that the order for the construction of a big liner to be built in France has not yet been placed. As to the *France*, she sailed from Havre on May 10, on her first trip as an oil-burner, and arrived back at Havre on May 27; the average speed for the two voyages was about 23 knots.

Naval Construction

On May 21 there was launched from the naval dockyard of Brest the new cruiser *Primauguet*, of 8,000 tons displacement, 181 meters long. It will be remembered that the first stage of the naval programme, which was decided after the war, comprises the construction of three 8,000-ton cruisers; the two others are the *Duguay-Trouin* and the *Lamotte-Picquet*. The propelling machinery of these three cruisers which consists of four Parsons turbines developing a total power of 110,000 horsepower is being constructed by three private firms (Chantier et Ateliers de Saint-Nazaire-Penhoet, Forges et Chantiers de la Mediterranee and Chantiers et Ateliers de la Loire). A drawing showing one of these cruisers as they will appear when completed was published in the January number. Their service speed will be about 33 knots. As stated in my last article, the French Government has been authorized by Parliament to lay the keels of two new 10,000-ton cruisers in 1924.

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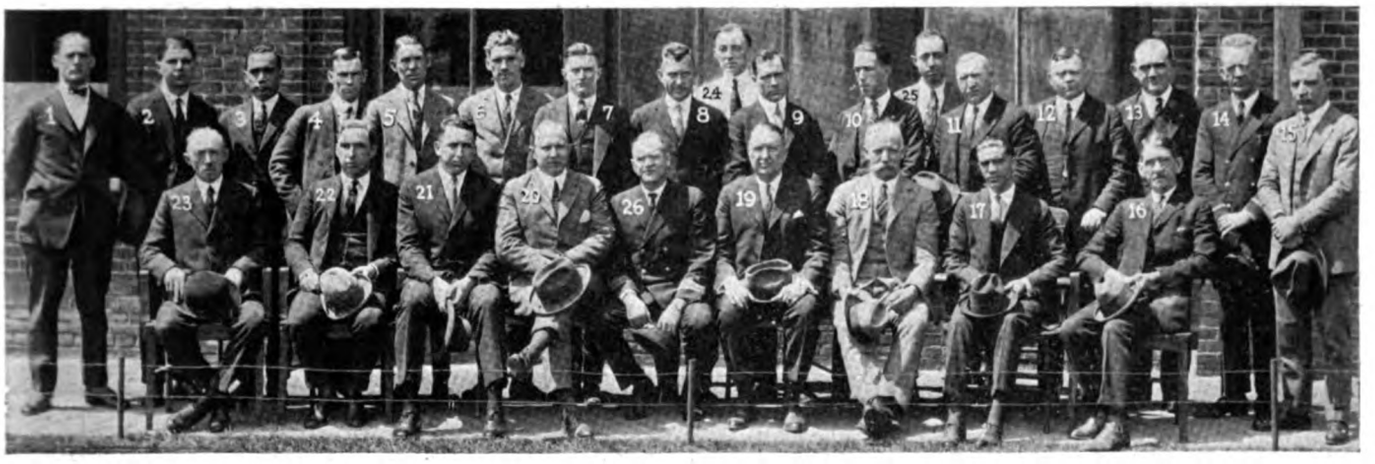

Shipping Board Fuel Oil Class No. 38 at Fuel Oil Testing Plant, Navy Yard, Philadelphia, Pa.

(1) P. Villagran. (2) R. F. Gagg. (3) A. Young. (4) H. E. Huntley. (5) J. D. Boyd. (6) C. Rubach. (7) F. W. Bayne. (8) D. R. Smouse. (9) J. Olsson. (10) F. J. Walker. (11) D. Anderson. (12) A. Gehre. (13) Edvard Rogers. (14) W. H. England. (15) Lt. F. E. Fitch. (16) J. A. Walker. (17) R. S. Lanteri. (18) C. Cook. (19) C. P. Burt. (20) L. E. Lasier. (21) J. A. Bryant. (22) Hugh Henry. (23) L. Peglow. (24) Lt. Porter (attached to Fuel Oil Test Plant). (25) Mr. Brierly (Technical Aid, Fuel Oil Test Plant). (26) Lt.-Comdr. H. G. Donald (Commanding Officer, Fuel Oil Testing Plant).

Shipping Board Announces Honor Roll of Engineers

BELOW is published the honor roll of chief engineers sailing out of the Port of New York for the period ending December 31, 1923, which has just been announced by the Fuel Conservation Committee of the Shipping Board. This honor roll represents those chief engineers of Shipping Board vessels who have made excellent records as regards fuel economy and engineering performance and is one of the steps taken by the Fuel Conservation Section in an endeavor to stimulate interest and competition among the various vessels.

The Fleet Corporation has just authorized the payment of a bonus of $50.00 each to every man whose name appears on honor rolls commencing with that for the present period. In this way the Fuel Conservation Committee hopes to still further stimulate interest and competition among the engineers in maintaining their department of the vessels in a high state of efficiency.

HONOR LIST OF CHIEF ENGINEERS WHO HAVE SHOWN OUTSTANDING OPERATING EFFICIENCY ON SHIPPING BOARD VESSELS SAILING FROM THE PORT OF NEW YORK, FOR HALF YEAR ENDING DECEMBER 31, 1923

Chief Engineer — Vessel — Operator

Thompson, T.—*Archer*, Barber Steamship Lines.
Edes, Everett N.—*William Penn*, Barber Steamship Lines.
Bernson, E. J.*—*Eclipse*, Barber Steamship Lines.
Brown, Geo.*—*Elkton*, Barber Steamship Lines.
Murray, E. H.—*Scottsburg*, Barber Steamship Lines.
Augustine, L.—*Stanley*, Barber Steamship Lines.
Adams, C. S.*—*West Cherow*, Black Diamond S. S. Company.
Griffin, D. J.—*West Inskip*, Black Diamond S. S. Company.
Fletcher, W. A.—*Innoko*, Black Diamond S. S. Company
Anderson, J.*—*Ala*, Black Diamond S. S. Company.
Stewart, P. S.*—*Anaconda*, Black Diamond S. S. Company.
Woodcock, W. F.*—*Westerner*, Black Diamond S. S. Company.
Trent, Thos.—*Conejos*, A. H. Bull & Company.
Gray, Wm. F.*—*Sangamon*, A. H. Bull & Company.
Denison, L. H.—*West Kedron*, A. H. Bull & Company.
Pancott, Arthur*—*Waukegan*, Cosmopolitan Shipping Corporation.
Adams, F. R.*—*Pipestone County*, Cosmopolitan Shipping Corporation.
Crisp, G. B.*—*McKeesport*, Cosmopolitan Shipping Corporation.
Wise, F. B.*—*McKeesport*, Cosmopolitan Shipping Corporation.
Hall, J. W.*—*McKeesport*, Cosmopolitan Shipping Corporation.
Thorsby, M. S.*—*Vincent*, Cosmopolitan Shipping Corporation.
Clark, J. M.*—*Eglantine*, Cosmopolitan Shipping Corporation.
Fenwick, F.*—*Sarcoxie*, Cosmopolitan Shipping Corporation.
Lotz, E. W.—*Winona*, Export Steamship Corporation.
Woodrow, C.—*Dochet*, Export Steamship Corporation.
Illhardt, A.*—*Abron*, Export Steamship Corporation.
Topping, R. L.*—*Liberty Glo*, International Frtg. Corporation.
Rice, Clay*—*Casper*, International Frtg. Corporation.
Blanchard, W. H.*—*Haleakala*, International Frtg. Corporation.
Brubach, F. W.—*Arcturus*, Kerr S. S. Corporation.
Post, B.—*West Mahomet*, Kerr S. S. Corporation.
Turpin, J. E.—*Nile*, Kerr S. S. Corporation.
Hodges, J. B.*—*West Calumb*, Kerr S. S. Corporation.
Hodges, J. B.*—*West Canon*, Kerr S. S. Corporation.
Parker, M. A.*—*Eastern Glade*, Mallory Transport Lines, Inc.
Urwin, S. L.—*Wheaton*, Mittnacht, A. E.
Auld, J. T.—*Neponset*, Mittnacht, A. E.
Lean, E. O.*—*Kerhonkson*, Moore & McCormack.
Carter, W. M.*—*Natirar*, Moore & McCormack.
Strubing, H. E.*—*Pan America*, Munson Steamship Lines.
Richardson, J. L.*—*Pan America*, Munson Steamship Lines.
Thomson, J. W.*—*Western World*, Munson Steamship Lines.
Strubing, H. E.*—*Southern Cross*, Munson Steamship Lines.
Stuart, B. M.—*Southern Cross*, Munson Steamship Lines.
Fleming, A. O.—*American Legion*, Munson Steamship Lines.
Elliot, E. M.—*Bibbco*, Munson Steamship Lines.
Erskine, J.—*West Corum*, Munson Steamship Lines.
Gilkey, W. P.—*Artigas*, North Atl. & Western Company.
Miller, S. J.—*Lehigh*, North. Atl. & Western Company.
Yandell, F. C.—*President Adams*, United States Lines.
Anderson, C. R.*—*President Garfield*, United States Lines.
Turner, J.*—*President Garfield*, United States Lines.
Condon, J. W.—*President Monroe*, United States Lines.
Swatridge, W. O.—*President Polk*, United States Lines.
Styron, A. W.*—*President Van Buren*, United States Lines.
Desmond, J.*—*President Van Buren*, United States Lines.
Rakow, J. W.*—*President Harding*, United States Lines.
Anderson, C. R.*—*President Harding*, United States Lines.
Robbins, E. S.*—*President Roosevelt*, United States Lines.
Rakow, J. W.*—*President Arthur*, United States Lines.
Harrington, G. E.*—*President Arthur*, United States Lines.
Kennedy, H. A.—*President Arthur*, United States Lines.
Cook, C.—*President Fillmore*, United States Lines.
Rakow, J. W.*—*America*, United States Lines.
Brennan, P.—*America*, United States Lines.
Hodgekiss, W.*—*George Washington*, United States Lines.
Holmes, W. J.—*East Wind*, United States & Australia.
Bridges, Wm.—*Easterner*, United States & Australia.
Nilson, A.—*Eastern Planet*, United States & Australia.
Winlaw, T.*—*Eastern Moon*, United States & Australia.
Nash, Peter—*Eastern Sea*, United States & Australia.
Richards, W.—*Cape May*, United States & Australia.
Leslie, W.*—*Eastern Leader*, J. H. Winchester & Company.
Skelton, H. F.—*Eastern Pilot*, J. H. Winchester & Company.
Jackson, A. W.*—*Eastern Guide*, J. H. Winchester & Company.

* Attended Fuel Oil School.

Oil Engine-Electric Driven Tug Launched

ONE of the first oil-electric tug boats in the world, the *Van Dyke I*, was launched June 7 by the Staten Island Shipbuilding Company, Staten Island, N. Y. This is the first of three oil engine-electric driven tug boats, building for the Atlantic Refining Company of Philadelphia. Each tug boat is equipped with two Ingersoll-Rand Price-Rathbun oil engines direct-connected to General Electric generators, which supply current to General Electric motors, for driving the boats.

New Steel Oil Barge Placed in Service in New York Harbor

The Seaboard Shipping Corporation, 113 Broad street, New York, has placed in service at New York an additional modern all-steel 8,300 barrel capacity oil barge 158 feet long for the purpose of transporting bulk petroleum products either in New York harbor or along the coast. The barge is fitted with a Warren duplex steam pump, 14 inches by 12 inches by 18 inches, having a pumping capacity of 2,000 barrels an hour at 100 pounds pressure.

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TRADE PUBLICATIONS

CORRECT LUBRICATION.—The best principles of lubricating motor boat engines have been outlined in a booklet just issued by the Vacuum Oil Company, New York. In this booklet lubrication in general is discussed and special sections are devoted to Diesel engines and surface ignition engines.

ELECTRIC HAND LANTERNS.—In folder No. 10 the Crouse-Hinds Company, Syracuse, N. Y., demonstrates several new ideas in electric hand lanterns. Two special types, the LM and VSB, are illustrated and described. Both lanterns are vapor proof and particularly useful wherever combustible vapor, gas or dust is present.

ICE AND FROST.—This Bulletin, published by the Frick Company, Waynesboro, Pa., discusses the uses of mechanical refrigerating plants with special reference to Frick enclosed compressors and refrigerating equipment. Various types of refrigerating machines are described in detail and numerous illustrations of typical installations are given.

FITTINGS FOR PIPE STRUCTURES.—In a 36-page publication, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is announcing a new and complete line of interchangeable pipe fittings for structural work. This publication, known as circular 1676, describes the fittings and gives their application to such work as the erection of outdoor sub-stations, switching equipment, switchboard frames, racks, railings, fences, etc.

SINGLE STAGE FIRE PUMPS.—Single stage underwriter's fire pumps, as specified and approved by the Associated Factory, Mutual Fire Insurance Company and by the Underwriters' Laboratories of Chicago are described in a four page leaflet issued by the De Laval Steam Turbine Company, Trenton, N. J. In an accompanying leaflet, the use of single stage fire pumps in several of the large mills of Lowell, Massachusetts, is described.

SCOVILL CONDENSER TUBES.—A new booklet on condenser tubing, prepared by the Scovill Manufacturing Company, Waterbury, Conn., contains a brief non-technical description of the cupping process and other operations in connection with the manufacture of Scoville Admiralty condenser tubing as well as the process for making Scovill special Muntz condenser tubing. In connection with this booklet separate specifications have been printed for both Admiralty and Muntz condenser tubing which cover the manufacture, chemical properties and tests, physical properties and tests, permissible variations in dimensions, workmanship and finish.

BUSINESS NOTES

The Luckenbach Steamship Company has opened a Buffalo office at the Ellicott Square Building in charge of F. J. McGlynn.

The offices of the International Mercantile Marine at 550 Market street, San Francisco, are to be transferred to the Postal Telegraph Building, 460 Market street.

The Steele Steamship Company has been appointed agent at New Orleans for the Moore & McCormack Company's Philadelphia, Wilmington, Del., and New Orleans service.

The Bethlehem Shipbuilding Corporation, Ltd., Bethlehem, Pa., has been made distributor for marine installations of the new firefoam stabilizer Amdyco, a product of the American Dye Wood Company, New York city.

K. A. Hills, since January attached to the Davenport, Iowa, sales office of the General Electric Company, was recently made manager of that office, covering a territory including a large part of the State of Iowa.

S. E. Gates, for fourteen years in charge of the Spokane, Wash., office of the General Electric Company, has been appointed manager of the Los Angeles office. Bernhard Olsen succeeds Mr. Gates as manager of the Spokane office.

The De Laval Steam Turbine Company, Trenton, N. J., has announced the formation of a Pacific coast sales organization covering the states of California, Oregon and Washington and sections of the adjoining states, under the direction of William Pullen, with offices in Los Angeles, San Francisco and Seattle.

H. A. Sparrow has joined the Robert June Engineering Management and Industrial Advertising Organization of 8938 Linwood avenue, Detroit, Mich. Mr. Sparrow is a graduate of Rensselaer Polytechnic Institute with the degree of M.E. He has served in the capacity of assistant sales and advertising manager of the London Steam Turbine Company of Troy, N. Y., and later as plant engineer with the New York Telephone Company of Brooklyn.

The authorized capital stock of the Westinghouse Electric and Manufacturing Company was increased from $125,000,000 par value to $200,000,000 par value at a meeting of the stockholders held June 11 in the main office of the Company at East Pittsburgh, Pa.

At this meeting the following directors were elected:

Of the class whose term will expire the second Wednesday of June, 1928; Guy E. Tripp, chairman of the board, Westinghouse Electric and Manufacturing Company; H. H. Westinghouse, chairman of the board, Westinghouse Airbrake Company; Joseph W. Marsh, president, Standard Underground Cable Company; and Albert H. Wiggin, president, Chase National Bank of New York.

Of the class whose term will expire the second Wednesday of June, 1925; H. P. Davis, vice-president, Westinghouse Electric and Manufacturing Co.

Of the class whose term will expire the second Wednesday of June, 1927: L. A. Osborne, vice-president, Westinghouse Electric and Manufacturing Co.

MARINE SOCIETIES

AMERICA

American Society of Naval Engineers
Navy Department, Washington, D. C.
Secretary-Treasurer—Commander Bryson Bruce, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

Society of Naval Architects and Marine Engineers
29 West 39th Street, New York
Secretary and Treasurer—Daniel H. Cox.

National Association of Engine and Boat Manufacturers
29 West 39th Street, New York City
Secretary—R. R. A. Hand.

United States Naval Institute
Naval Academy, Annapolis, Md.
Secretary and Treasurer—Commander H. K. Hewitt, U. S. N.

American Marine Association
15 Park Row, New York
President—Frank J. Shipman.

The New York Tow Boat Exchange
11 Moore St., New York.
Secretary—Irving G. Keller.

Port of New York Authority
11 Broadway, New York
Chairman—E. H. Outerbridge.
Secretary—William Leary.

National Association of Masters, Mates and Pilots
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

American Society of Marine Designers
Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass.

National Marine Engineers' Beneficial Association
Headquarters 311-315 Machinists Building, Washington, D. C.
Secretary-Treasurer—George A. Grubb.

Atlantic Coast Shipbuilders' Association
1600 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

Council of American Shipbuilders, Inc.
30 Church St., New York
President—Homer L. Ferguson.
Secretary-Treasurer—Henry C. Hunter.

American Steamship Owners' Association
11 Broadway, New York
President—Alfred Gilbert Smith.
Vice-President and General Manager—Winthrop L. Marvin.

United States Ship Operators' Association
149 Broadway, New York
President—C. H. Potter.

National Merchant Marine Association
Munsey Bldg., Washington, D. C.
President—Hon. J. E. Ransdell.

The Maritime Association of the Port of New York
78 Broad St., New York City
President—Charles H. Potter.
Secretary—Walter F. Firth.

Lake Carriers' Association
President—Wm. Livingstone, Dime Bank Building, Detroit, Mich.
Secretary—George A. Marr, Rockefeller Building, Cleveland, O.

Neptune Association
21 Pearl St., New York City
Secretary-Treasurer—Captain John F. Millikea.

Ocean Association of Marine Engineers
15 Whitehall St., New York City
Secretary—Bert L. Todd.

CANADA

Grand Council N. A. of M. E. of Canada
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.

GREAT BRITAIN

Institution of Naval Architects
Adelphi Terrace, London, W. C.

Institution of Engineers and Shipbuilders in Scotland
39 Elmbank Crescent, Glasgow.

Northeast Coast Institution of Engineers and Shipbuilders
Bolbec Hall, Westgate Road, Newcastle-on-Tyne

Institute of Marine Engineers, Incorporated
85/88 The Minories, London, E.1.

ITALY

Collegio Degli Ingegneri Naval e Meccanici in Italia

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